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Contracting Practice.

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ITEMIZED QUANTITY ESTIMATES.

CAREFULNESS and methodical attention to detail are much more important in taking off quantities than in setting the price for the individual kinds of work.

The quantities for any one job in their various proportions exist for that job alone and there is nothing to guide judgment or mental checking on the basis of past experience. The quantities of the different kinds of work when set forth on an estimate sheet must be accepted as correct, but they possess this desirability just so far as the estimate has been carefully prepared by a competent estimator. The majority of estimators have their own peculiar ideas as to the manner in which the work is taken off, the form in which notes are made and preserved in the working up of the final; generally, it will be found that such notes, even when preserved in an estimating book, will be so obscure that it is almost impossible for any other man to check the results.

As mentioned before, the checking of the cost estimate is much more certain and mistakes can be discovered for the reason that all branches of work have certain unit prices, varying between usual limits. Any seeming inconsistency is at once apparent to the eye and can be investigated and either confirmed or revised.

We must, therefore, establish some system and method of recording the quantities as they are taken off, part by part, in order that we may have the opportunity of independently checking and preserving the notes in complete detail. This is preferably done by such a blank form as is shown in Plate VI. If a form of this kind is used we secure all these advantages and in addition we have on file a complete statement of the job so itemized and in such form that should the job be secured no changes can be made in any of the working plans over the preliminary plans on which the work is based. In cases where preliminary plans are returned, with possibly a delay before awarding of the contract, and then working plans furnished, it is well to at once check off on the itemized quantity estimate the quantities as shown by the working plan. Many times, the preliminary plans are not made complete in all details, with the result that when the working plans are prepared and all details worked out revisions and changes will be necessary in the general plans. If, as is usual, the preliminary plans have been returned, the only record remaining in the hands of the contractor is this itemized quantity estimate.

Right here, it may be well to lay all the stress possible upon the fact that any contractor receiving a set of plans and specifications should at once mark on each sheet of the plan the date and his name in ink, so that in case the work should be awarded him he may call for the exact set of plans and specifications which were in his possession at the time of making his proposition. This is not advocated because we must be suspicious of dishonesty or manipulation, but it is a fact that in the preparation of various sets of plans and specifications there is always the opportunity for typographical errors, failure to bind in all sheets, omission of details and failure to make revisions and corrections on some of the sets. Also, many times as revisions are made (and especially where the letting of the work is delayed from time to time, due to such revisions and receipt of additional proposals) there is accumulated a multiplicity of blue prints, etc., which are out of date. Now, if these sheets are preserved they are a menace to the contractor, as they may, through error, not be replaced with the new sheets. On the other hand, if they

are destroyed there is nothing with which to compare the revision, as the architect or engineer in nearly all work makes his revisions by erasures and additions to the original tracings, and, therefore, the tracings themselves bear no adequate means of identifying the original drawing.

These same conditions apply during the entire construction of the work, and generally the first plans are called in and the new plans substituted. The writer knows of one case on a large and important piece of work where the architect made a rule that no revised plan would be issued until the first plan had been returned and destroyed, and from this rule there could be no deviation. It was found that the first set of plans was deficient in many details and as a result the quantity of work was largely increased. The method adopted by this architect, whether prompted by proper motives or not, had the effect of covering up the mistakes and discrepancies in his original plans. As the work was complicated and constantly changing in size of members, etc., the contractor was placed in the position of unwittingly doing more work than he had really contracted to do.

The itemized quantity estimate, as proposed in Plate VI, is the result of a personal experience in errors in quantity estimating and in loss due to just such conditions as were last mentioned. It is for the purpose of providing as far as possible against future errors that this form has been developed. It has been used and it has been demonstrated that with proper care a reasonable amount of certainty may be expected. This quantity estimate when prepared in the manner suggested is also of great value when the time comes to submit a schedule of quantities and prices for the preparation of the monthly estimates and naturally forms the basis of the preparation of the amount of each class of work for each month's estimate and by this system the preparation of estimates is simplified and made so systematic that the estimates will form a definite series tied together, so that at all times by it is shown exactly what amount of work has been accomplished and what percentage of the work completed.

It will be noted that the itemized quantity estimate bears for all practical purposes the same style of heading as that previously given for "Outline of Work," Plates II and II. By carrying through this general heading and the same estimate number, all of the estimates, plans and papers are preserved in their proper place.

It is expected in using this blank form that each calculation forming a part of the determination of quantities shall be set forth under each item of work. This being the case, and as there generally will be several calculations for each kind of work, the latter will show very prominently in the first column and there is very little opportunity of anything being overlooked.

The next two columns, bearing as they do a reference to plans and specifications, furnish a very ready index with practically no extra labor to the estimator.

The next column is important. The location of that portion of each kind of work under process of calculation should certainly be noted. If this is done, how much easier it is to check the quantities at any time and how much more definite the estimate and connection of the quantity estimate with the proposed work.

The next column furnishes all the necessary dimensions for the determining of any kind of work entering into the job when used with the unit columns for the various classes of work entering into the item of principal work. It might be well, here, to bring out the point that the classification of work as called for by plans and specifications is much less complete than the classifications of different items of work which must be estimated by the contractor, and yet the contractor must retain the specified classifications, either for unit price bidding or for submission of schedules in lump sum bidding, or percentage contracts.

The itemized quantity estimate, Form Plate VI, is so arranged that the various divisions desired and required by the contractor are separated by the columns at the right hand side of the sheet. These columns provide for a unit and a total, the unit column being intended for the usual multiplier or divisor in order to place within the total column the quantity as based upon the dimensions. The headings for these columns are to be written in according to the practice of the individual contractor and opposite each main item of work.

Referring to Plate VI, various illustrations are given of the manner in which main items of work may show their location, part by part, giving the dimensions of such portions, and then immediately following are given the separations or secondary classifications into which the main items must be divided in order to make an intelligent estimate. In presenting these illustrations no attempt has been made to illustrate the application to any particular kind of job, but, instead, various kinds of work are shown which in all probability are likely to occur in any kind of construction.

The use of this blank can be made universal, but the individual application must depend upon the contractor's line of work

CONTRACTING PRACTICE — PLATE VI

A-B-C CONST'R CO.

ITEMIZED QUANTITY ESTIMATE

NATURE OF WORK Illustration of use of this form

WHERE LOCATED _____

OWNER _____ ARCH OR ENGR. _____

EST. NO.	41
SHEET NO.	1
DATE	7/10/11
ESTIMATED BY	FB
EXTENDED BY	M.V.L.
RECAPITULATED BY	FB
CHECKED BY	O.K.M.
REVISION SEE SHEET	

GROUP ITEMS WITH BRACKETS		ITEM OF WORK	LOCATION	SHEET PLANS	PAGE SPEC.	DIMENSIONS LENGTH	WIDTH OR HEIGHT	THICKNESS OR DEPTH	NO. OF PIECES	QUANTITIES BY UNITS & TOTALS — WRITE IN PROPER HEADING FOR EACH ITEM OF WORK: UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL
Excavation	1	Excav									Cubic Yards		Cubic Yards		Cubic Yards		Cubic Yards		Tunnel
	2		Main Wall	1	4	100	54	10		27	2000			S	9216			1/2	1000
	3		Alley Wing	1	4	54	27	12		27	648			S	4860			1/2	324
	4		Tunnel	2	5	400	3	15				27	666			27	20000		
	5	Totals									2648		666		14076		20000		1324
Reinforced Concrete	6	Concrete									Cubic Yards		Cubic Yards		Bbl Bags		Square Yards		
	7	1:3:6	Main Wall	2	6	308	12	Var 1½		27	205	3	11089		Mixed				
	8		Wing "	2	6	135	14	" 1½		27	105	3	5670						
	9		Base Mat	2	7	127	54	4'		27	85			8	680	36	428		
	10	Totals									395		16758		680		428		
	11	Concrete									Cubic Yards		Forms		Erection		Steel		Bbl Bags
	12	1:2:4	Columns	3	10/9	10	1½	1½	24	27	20	21	5040			6	1450		
	13		Girders	3	9	27	1½	2½	16	27	50	18	6048			10	4320		
	14		Roof	3	9/10	127	54	4'		27	85			4	27432	10	7338		68.6
	15		etc etc																
	16	Totals									155		11088		27432		13098		68.6
	17																		
	18										Sq Yds Concrete		Sq Yds Concrete		Joist		Tile		
Brick	19	Arch	St Faces	1	7/6	54	18	12"		15	12150	9/10	9720	7	5670				
	20		Girder "	3/6	"	173	18	13		22	57090	"	42810						
	21		Alley Wall	7	"	108	10	13"		22	23760	"	17820						
	22		Wing Side	6	"	81	10	8"		15	12150	"	9120						
	23		Partition	8	"	27	8	8"		15	3240		2430						
	24		Stack	8	16	40	3 flues	874"		15	7200		5400			7	3360		
	25		etc																
	26		etc																
	27	Totals																	
	28																		
	29																		
Steel	30	Structural								#	12" I		10" I		6" I		4x4 L		C I Cols
	31	Steel	1st Floor	6	15	14			32	40	17920								
	32		2nd "	6	15	14			32			32	14336						
	33		1st Floor	"	"	10			64					18	11520				
	34		2nd "	"	"	10			64					13	8320				
	35		Roof	"	"	14			32			32	14336						
	36			"	"	10			32					13	4160				
	37		1st Floor	"	"	14			64							3	1152		
	38		2nd "	"	"	"			"							"	1152		
	39		1st "	6	16	10	6"	7/8	24									46	10580
	40		2nd "	6	16	10	6"	½	24									27	6480
	41		etc etc																
	42	Totals																	
	43																		
	44	Reinforcing									#		5/8		½		¼		¼ & ½
	45	Steel	Columns	3	9/9	12	3/4		4 134	13	1728								
	46		" Hoops	"	"	50			24									3	400
	47		Beams	3	9	27	4 & 3/4 W-38		4 & 10 4 & 20	15	2682	10	1728						
	48		Floors	3	10	20		06"	960							3/5	11466		
	49		Roof	"	"	20		06"	960								3872		
	50		etc																
	51		etc																
	52	Totals																	
	53																		
Timber	54	Timber									6x12		8x8		3"T		1"T&G		12x12
	55		Columns	3	8	10			24									12	2880
	56		1st Floor	"	"	14			32	6	2688								
	57		2nd Floor	"	"	10			64			27	1728						
	58		1st Floor			100	54									Fe	19440	Sq	20250
	59		etc etc																
	60	Totals																	

PLATE VI. CONTRACTING PRACTICE.
Itemized Quantity Estimate.

and his individual ideas as to separation into component parts, the latter naturally depending upon the manner in which he keeps his cost record. The advantage of the form lies in the fact that instead of taking off different parts of each main item separately and repeating over and over again the given dimensions, the main item and dimensions are only given once and the other quantities are arrived at by the use of their proper units.

Referring again to Plate VI, and taking excavation: In any piece of work it will be necessary to state several dimensions in order to cover the shape of the excavation and varying depths. The quantities should be, of course, in cubic yards; therefore, the unit column carries the divisor 27. In excavation, however, it is generally the case that shoring or sheeting of the banks is necessary and the amount of such work is directly dependent upon the same dimensions, being the perimeter of the excavation times the height; therefore, the unit column under this heading provides the average thickness of all timber required, in inches, which gives the quantity in thousands of feet board measure. In case the excavation is of such a character that it may be expected to uncover gravel, which may be used in the construction, and it having been determined by test digging the depth at which it can be obtained, we find in the unit column "one-half" or any other proportion. Inasmuch as in any large job several detail calculations such as this are necessary in order to arrive at the grand total, we have each portion grouped by the use of this method so that each kind of work is stated exactly in proper relation to the work as a whole. If any item shows no such divisions it is at once apparent and investigation can be made to ascertain whether same was overlooked. This method also allows of a more intelligent pricing of the work, as the more complicated portions are automatically emphasized and may be priced accordingly, whereas, by any other method it is more than probable that averages would be taken over the entire work.

The same conditions apply to concrete, but to even a greater extent. Concrete as a main heading will in general be divided into main items of work where the proportions of the concrete mixture are varied and the location and dimensions of the work where any one mixture is to be used are grouped. We then have the unit item under concrete containing a divisor 27, as we wish our concrete quantity in cubic yards. The amount of forms required is directly dependent upon the square feet of surface area which are given by main dimensions. In the unit column is placed a multiplier giving the inches in thickness of the lumber necessary to form the facing, studding, braces, etc., all of which can be quickly calculated, and, really, after some experience, becomes a standard for various classes of work, the result is to give us our quantities of forms in thousands of feet board measure.

The method applies to centers the same as for forms, and the resulting quantities are in thousands of feet board measure, except that a separate item is necessary to list the amount of piling necessary in case of false work for bridge construction.

In building construction the reinforcing steel for various designs can be obtained from tables on a basis of unit pounds per square foot of floor and lineal foot of beams and columns, and these units should be placed in the unit column opposite the listing by dimensions and pieces of the various portions of the structure.

If there is more than one kind of steel there must, necessarily, be more than one column used for itemizing, on account of the difference in prices. If the structure is a steel one entirely or is a large reinforced concrete job with a complication in the size of bars and kinds of reinforcing or made up of standard structural shapes, then steel should be made a general item of work, and these unit columns become the proper method of the separation of the steel bars and shapes into their proper classification for standard prices and standard plus extras. In a complicated case of this kind with many divisions all that is necessary in case more columns are required than are provided by the standard sheet is to cut from other sheets and paste as many columns as are necessary on the right hand side. These columns can then be folded in without interfering in any way with standard procedure. Many other columns are at once apparent for separation for concrete work. For instance, waterproofing, if incorporated in the mass, is an element of the cubic yardage and should be listed opposite that portion of the work where same is required. If waterproofing is in the nature of the sheet method or surface application, it naturally depends upon the square feet of surface covered, which is shown by the dimensions of that part of the work where same is required. The unit column for waterproofing would, therefore, show unit pounds of compound per cubic yard or thickness in fractions of a foot to give results in cubic feet.

The same conditions apply to cement finish, filling under-work or over-work wood floors, marble floors, painting, plastering, etc., as all these items of work will appear opposite the portion of work where they are to be used, and as the dimensions of such parts of the work are clearly stated it is only necessary to place in the unit column proper unit mul-

DATA:-
Building 53×100
2 Sup. Floors & roof
Gen. Sh.-Long Span. Tile Constr.
Sq. ft. ___ per sq. ft.
Cu. ft. ___ per cu. ft.

A-B-C CONST'R CO.

ITEMIZED COST ESTIMATE

For Whom: Smith Mfg. Co. | Where Located: Metropolis
Work Included in Est.: General Contract | Nature of Work: R. Concrete Bldg.

Estimate No. 25
Sheet No. 1
Date 7-9-11
Designed By H.H.B.
Quantities By W.L.L.
Est. Priced By W.L.L.

	1 Principal Item	2 Quantity: Amt. From Itemized Quan. Est	Quantity: Unit	3 Unit Items Composing Principal Item: Item	Quotations on Material	Quan.	Price	6 Resulting Unit Prices Principal Item: Mat.	Lab	7 Total Cost of Material Col. 5 × 2	Total Cost of Labor Col. 5 × 2	9 Total Cost Mat. & Labor	10 Remarks
1	Excavation	510	Yds	Labor		510	75		.60		306		Dump 1 mile
2													
3	Filling	1000	Yds	Cinders	Pr. Cr. Co	25 yds	$2.00	.20		200			Belt R.R.
4				Labor					.60		600		
5	Forms	1114	M	Labor					27.00		3078		Union Lab.
6	Centers	120	M	Labor					17.00		2040		" "
7	Total F&C.	2334	M	Lumber		Use 1½ times	4/26	12.50		2925			Salvage consid.
8	Concrete	1650	Yds	Gravel	Co. Dock 65	9/10	1.00	.90		1485			B.R.S.&G.Co
9	(1:2:4)			Sand	" " "	46/100	1.00	.45		743			" "
10				Cement	A.P.C. Co.	1⅑	1.00	1.55		2557			
11				Water	Water Co.			.10		165			
12				Labor					1.75		2888		
13	S.P. Tile 6"	9500	Sq. Ft.	Tile	B.C. Co.	F.o.b.	.05	.05		475			
14	10"	18900	"	Tile	B.C. Co.	F.o.b.	.07	.07		1323			
15	Total	28400		Labor		"			.01½		426		
16	Reinforcement	3½	Tons	1/4" Sq's.	S.T. Co.	F.o.b.		45.00		146			
17		1/10	"	3/8" "	S.T. Co.	F.o.b.		43.00		17			
18		3/10	"	1/2" "	S.T. Co.	F.o.b.		40.00		12			
19		3 1/10	"	5/8 "	S.T. Co.	F.o.b.		39.00		140			Average 2 Miles
20		5	"	3/4 "	S.T. Co.	F.o.b.		38.00		190			
21		48	"	1/2 & 3/4	F.B. Co	F.o.b.		63.00		3024			Fabricated
22		20	"	1"	F.B. Co.	F.o.b.		58.00		1160			" "
23	Total	80.65/100	"	Labor		Fre.			10.00		805		
24	Exp. Metal	2000	Sq. Ft.		S.T. Co.	F.o.b.		4/100 .04		80			
25	Total			M.&L.						14642	10143		
26	Gen. Chg.			All Items					20%		2028		
27	Total			Cost								26813	
28	Profit					15%						4022	
29	Bid			Lump	Sum							$30835	
30													
31													
32	For Unit Price Bid on Concrete see Estimate below :-												
33													
34	Concrete	1650	Yds	Gravel		9/10	1.00	.90		1485			Unit Price
35	1650 Yds.	1650	"	Sand		46/100	1.00	.45		743			wanted on
36		1650	"	Cement	A.P.C. Co.	1⅑	1.00	1.55		2557			Concrete as
37		1650	"	Water				.10		165			additional
38		1114	M	Forms	Use 1½ times	69.00 M	1.25	.86		1419			stories may
39		120	M.	Centers	" " "	73.00 M	1.25	.91		1502			be added of
40		9500	Sq. Ft.	Tile 6"	f.o.b.	5¾/7	.05	.29		475			same type
41		18900	Sq. Ft.	Tile 10"	f.o.b.	11⅝ 39	.07	.80		1323			
42		80.65/100	Tons	Reinforcement		97.50	2.50	2.83		4689			See Itemization
43				Labor		Con.			1.75		2888		
44		1114	M.	Labor		Forms	3.50		1.86		3078		
45		120	M	Labor		Centers	1.75		1.24		2040		
46		28400	Sq. Ft.	Labor		Tile	.01½		.26		426		
47		80.65/100	Tons	Labor		Reinf.	10.00		49		805		
48	Total			M.&L.				8.69	5.60	14358	9237		
49	Gen. Chg.			All Items		20%			1.12		1847		
50	Total			Cost				15.41				25442	
51	Profit					15%		2.31				3816	
52	Bid			Per Cu. Yd. Concrete				$17.72				29268	
53													
54													
55													
56													
57													
58	See Sheets 2, 3, 4 and 5												
59													

PLATE VII. CONTRACTING PRACTICE.
Itemized Cost Estimate.

tipliers or divisors to secure the results in the desired quantity basis. This unit is naturally preserved along with the other complete data, and in case it is desired, for instance, to ascertain the additional cost, provided the cement finish in certain portions of the work is changed from ½-inch in thickness to ¾-inch, the information is obtainable almost instantly; whereas, if this method had not been followed it would be necessary to refigure the plans.

Timber and lumber can be taken off in the same manner, using the columns for the different sizes of timber at the various prices, and using the unit column for unit feet board measure. If the structure is a large one and many sized pieces are called for, all that is necessary is to provide additional columns, as is mentioned above under steel.

Brick work is peculiarly adaptable to this method of estimating. The various portions of the work are stated in the location column and the dimensions given; we then use our secondary columns to obtain the quantities of common brick, face brick, special brick, and in each case the separation is made directly opposite the respective locations, but the total is reached just as surely. The opportunity is also afforded for the statement in parallel columns of the amount of brick "Wall Measure" and "Kiln Count."

Remember that this should be an axiom for the contractor, that any estimate must be made by detail calculations. If such detail calculations are recorded as provided for by our form the totals are obtained readily; but a lump sum quantity estimate obtained from scratch pad calculations can never be separated without recalculation and uncertainty.

Illustrations could be carried on *ad libitum*, but the illustrations given are of sufficient extent to show the wide application of the method suggested, and it only remains for a few moments' thought to so arrange the form that same can be used for any class of work.

The extreme left hand column—"Group Items With Brackets"—makes doubly sure the obtaining of correct totals and adds materially to the clearness of the estimate. If, for instance, we have in the "Item of Work" column the heading "Concrete" and then follow on down the sheet with numerous items filling out the right hand columns, then by the addition of a bracket inclosing these items down to the total, the eye is enabled at a glance to read these results without confusion.

The advantage of this form of detail quantity sheet is not limited to the estimate, for in case the contract is secured it is relied upon for the ordering of material and the order in which same is to be delivered, all because each class of work is given by location, the unit applying to such work, and the quantity required for each portion. In any lump sum estimate this information could not be obtained without recalculation.

The quantity sheet also works in directly with the methods of cost analysis and the office and field system connected therewith. And above all, it is of importance in the division by sections and the recognition of same during the period of construction and analysis.

In taking off the quantities from the plans use common white crayon to check each item and each portion of the work as the quantity estimate is tabulated. When the estimate is completed and the plans are to be returned to the architect or engineer, or forwarded to a competitor, wash the prints with a soft rag soaked in gasoline and all defacement will be removed.

For the purposes of the preparation of the itemized quantity estimate where many extensions are required, some form of a non-listing calculating machine is almost indispensable. Such a machine insures accuracy and saves time and extra help, and because of its speed an estimate can be prepared and checked during preparation and delivered in a fraction of the time required by ordinary method. The cost of such a machine is not excessive and it is well adapted for all forms of work in a small office. In the larger office there should be an addition—a listing adding machine—in order to check the securing of totals.

The slide rule should not be used in estimating of quantities or in multiplications and extensions. It is not the author's idea to under-rate the slide rule, but in the contractor's practice it will serve a far better purpose in cost analysis, and for these purposes it is indispensable, if time is any object.

Itemized Cost Estimates.

Passing to the "Itemized Cost Estimate," which is directly dependent on the "Itemized Quantity Estimate" and the next and final step in the Estimate Department, we propose the forms shown in Plates VII and VIII.

Plate VII is to be used where all the work contemplated is to be performed by the contractor's own organization and where as a result it is necessary to enter into full detail as to the costs of each and every item of work.

Plate VIII is to be used for the tabulation of those portions of the work where the contractor accepts sub-bids in lieu of making his own estimates or in addition thereto.

The headings of these forms are practically the same as for the "Itemized Quantity Estimate," except that the estimate is made more definite by stating

DATA:- Cost per 20 Ft. Gen. Ext.

Excav. etc.	—	—	—
R. Con. etc.	—	—	—
Mill Work etc.	—	—	—
Painting etc.	—	—	—
etc etc.	—	—	—

1 2

A-B-C CONST'R CO.

3 For Whom: Smith Mfg. Co.
4 Work Included in Est: General Contract
5 Where Located: Metropolis
6 Nature of Work: R. Concrete Bldg.

ESTIMATE No. 25
SHEET No. 4
DATE 7-9-11
DESIGNED BY [illegible]
QUANTITIES BY W.T.L.
EST. PRICED BY J.M.H.

7 8 9

	Principal Item	A-B-C-Cos. Est. Quantity Amt	Unit	Unit Price	Total	Name of Sub Bidders	Sub Bids	Selected Sub Bids for Est. of Cost	Unit Price Sub Bids	Remarks
1	Cement	5750	Sq. Ft.	11¢	633	Block Mfg. Co.	690	690	12¢	
2	Blocks.					John. Smith	725		12 6/10¢	
3						Cement Block Co.	745		13¢	
4										
5	Cement	1150	Lin. Ft.	25	288	Block Mfg. Co.	345	345	30¢	
6	Sills					John Smith	360		31 2/10¢	
7						Cement Block Co.	375		32 5/10¢	
8										
9	Cement									
10	Coping	525	Lin. Ft.	25¢	131	Block Mfg. Co.	258		49¢	
11						John Smith	240		45 7/10¢	
12						Cement Block Co.	225		43¢	
13						Use Co. Est.		131		
14										
15	Mill Work.				2000	Metropolis Lum. Co.	2120			See
16						Jones & Brown.	1600			Detail
17						Doe-Roe Co.	1860	1860		Est.
18										
19	Wood Sub.	70	M.	40.00	2800	1. Metropolis Lum Co.	3500		50.00	Laid
20	Floor					2. Jones & Brown.	2450		35.00	Mf. f.o.b.
21						3. Doe-Roe Co.	3000		42.10	Laid but Cut up Space
22						Use Average 1 & 3		3250		
23										
24	Maple									
25	Floor	50	M.	40.00	2000	1. Metropolis Lum. Co.	2100		42.00	Laid
26						2. Jones & Brown.	1500		30.00	Mf. f.o.b.
27						3 Doe-Roe Co.	2000	2000	40.00	Laid
28										
29	Sheet				No. Est.	Sheet Metal Co.	600	600		
30	Metal					Cornice Works	675			
31										
32	Painting	2000	[illegible]	.50	1000	H. J. McMicheals	980			?
33	Glazing &c.					C. I. Dunlop	1020	1020		
34						Compton & Baker	1200			
35										
36	Fire Doors	20 1000	[illegible]	1¢	1000	Fire Door Co.	923	923		Installed
37						X Hardware Co.	923			
38										
39	Etc									
40										
41	Etc									
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PLATE VIII. CONTRACTING PRACTICE.
Sub-Contractors' Bids.

"for whom" the bid is prepared and the "work included in estimate." This is good information, especially if only a portion of the work is included and figures are made for general contractors. Perhaps the same work may be the subject of two or more estimates as a preliminary one to the owner or architect and a final to the same or to general contractors and the notation explains any discrepancies.

Referring to Plate VII, columns 1 and 2 are taken directly from the "Itemized Quantity Estimate" recapitulation of totals. These principal items are now dissected to analyze the cost which in all cases demands the separation of material and labor and also, generally, will require several items for materials which go to make up the principal item. Also, many times the labor must be separated into the different operations entering into the complete handling of the materials. Columns 3, 4 and 5 are used for this dissection by first stating the items, then any quotations received, then the quantity and price of sufficient of the secondary materials and labor to form one unit quantity of the principal item. The result is Column 6, the resulting unit price per unit of quantity as given in Column 2. Columns 7 and 8 give the totals for materials and labor and should be totaled separately before carrying to the "Total Cost Material & Labor," unless, for some reason, it is necessary to separate the work into sections, when, naturally, intermediate grand totals are given.

The labor column must, however, be footed independently and for the complete work in order to provide for "General Charges," as will be explained later.

This estimate is just as adaptable for unit price bids as for lump sum bids, the only difference being that for lump sums the total of Column 9 is used, whereas for Unit Bids the various totals in Column 6 for items Column 1 are used with the General Charges and profits added to each unit price for each item as the Estimate proceeds, and totals extended to Columns 7, 8 and 9.

In the latter case, the contractor not only has a tabulated record of his bid prices, but also his estimated quantities and the amount of materials, labor and total.

Each and every class of work to be performed by the contractor should be treated as a principal item, regardless of the classification of the specifications. For instance, forms for concrete should be given in feet board measure and not added as a guess amount per cubic yard of concrete, as is too often done.

Consider that a wall 12 inches thick requires practically just as much form work as a wall 27 feet thick or 54 square feet of surface per cubic yard as against 2 square feet. This in an extreme example, but in practice a large difference will be found.

The same thought applies to reinforcing steel for concrete.

In brick work practically the same cost is incurred, whether the wall is 12 inches thick or 36 inches. Surely, the cost per thousand is different.

The labor cost of pile driving is made up of two labor charges, viz: 1st. Rigging and Removing Outfit; 2nd. Driving. Assuming a cost to rig and remove outfit of $300.00 and two jobs—one of 3,000 lineal feet and one of 30,000 lineal feet—when it comes to the actual driving the cost should not vary to any great extent, yet the rigging and removing in the first case is ten cents per lineal foot and in the second case, one cent. Wild bids can many times be explained this way.

Be sure to analyze each item, and following through the job in imagination determine all the elements which enter into each operation. Build the job step by step in your own mind and thereafter you will never set down any guess costs or take snap judgment that the cost is so much because on another job that was the result.

As an illustration of this form, suppose we take as an example a concrete job of any character requiring excavation, piling, foundation concrete, superstructure concrete, forms and centers, reinforcement and cement finish. This Estimate is carried to completion two ways: 1st. For lump sum bid; 2nd. For unit price bid. General charges are included, but for the present we will pass the detail determination of same, as an entire article will be little enough space to give to this element of the cost, which in its insidious way eats into the anticipated profits, sometimes to final dissolution.

Upon the face of this Estimate Sheet we have every detail calculation of the cost and why it is so. By simply referring back to the Itemized Quantity Estimate we have detail calculation of the quantities and why it is so. There is no guess work about such a system, for even if some items are uncertain of determination by the plans such items stand by themselves and can be verified or mention made in the proposal that a certain amount has been estimated.

Any questions by the owner or architect can be answered at once and definitely. Any eliminated items can be deducted without recalculations.

Plate VIII contemplates that when any portion of the work is to be sub-let, still the contractor will make his own estimate of the quantity of such work and what in his judgment is a fair unit price. This method serves as a check on the

sub-bidders and also provides a basis for determining the unit prices at which the various sub-bidders are estimating.

The first three columns are used for the contractor's own estimate, while the balance of the sheet is for tabulation of sub-bids.

Both Plates VII and VIII should be 8½ x14 inches, as this size is just as convenient for filing and the extra length saves labor in forwarding totals.

The "Outline of Work," "Itemized Quantity Estimate" and the two forms of "Itemized Cost Estimate" should be bound together in order, preferably on the side in a loose leaf binder. Each Estimate as made should be placed in this binder in the order of the estimate number and an index provided.

In a large office it is better to file the Outline of Work and Itemized Quantity Estimate in one binder in the estimating or engineering department, while the Itemized Cost Estimate is personally in the hands of the contractor or a strictly confidential employee.

The amount to be added to the estimate for rental or depreciation of plant and equipment depends upon the "Scheme of Operation." The writer's practice in the case of new equipment is to add to the estimate the difference between the cost price and the second-hand sale value, using judgment in the determination of this depreciation with regard to the character and probable wear and tear of each class. This depreciation will, however, usually vary from 40 per cent. to 60 per cent. In the case of equipment on hand, it is a matter of choice whether a rental is added in addition to profit or whether the use of such a plant shall be considered as included in the added profit and thus presumably gain an advantage over less fortunate competitors. The subject of maintenance of equipment is, however, a separate charge over and above any rental or depreciation and is a true cost to be charged to each job. Various methods have been suggested, but for simplicity the writer advocates a Repair Account which forms a part of the General Charge. This subject will be treated under a separate article wherein all of the proper charges to the accounts will be listed. Properly speaking, this is "Material Cost Bookkeeping" and arises and should be treated under Construction.

Only under exceptional cases should rentals or depreciation be added as part of the unit cost of any item. By so doing a fictitious idea is obtained of the estimated cost of the item and in addition the total amount set aside for this cost can only be obtained by recalculation. In addition, the method is cumbersome and indefinite and will not stand investigation and analysis as will the percentage method of General Charge. The method of charging out the difference between the cost and second-hand selling value in the case of new equipment is based on the theory that the repair account is charged to the job and that if the plant is properly looked after the machinery is always in first-class second-hand condition and may so be carried on inventories. If a rental is charged or in case equipment is leased to others, 10 per cent. per month or a life of ten months on the first cost is not unreasonable, except on large contracts, on the theory that the plant as earning investment, less repairs, is worth the price.

In making the estimate, arrange the items in the logical order of sequence, as they would naturally occur in the actual construction. Building up the estimate in this way there is very little chance of overlooking items. A contractor who lacks imagination is certainly in the wrong line of work. Such a mental construction of the proposition, step by step, will many times call to attention items which do not appear in the plans and specifications. We can not anticipate all contingencies, but it is possible to build in the mind a model of the particular proposition.

Throughout, the idea of this series of articles has been to refrain from stating any cost data based on actual experience, on the idea that such costs are of little value, except to the individual to whom they occur, and *that* in his own "bailiwick." Our purpose has been to emphasize the methods whereby each individual, in any locality, can analyze and develop his own system.

Material costs are readily obtainable. Labor costs are uncertain, depending as they do on character, class, nationality, and environment of men employed and the circumstances and difficulties surrounding the work. We are writing for the contractor of experience who will accept suggestions as to methods, and for the young man who desires the ground work upon which to build up an organization. The contractor knows his labor and what he can expect as a day's work. The young man should serve his time with an established organization, keeping his own notes and forming conclusions which, if supplemented by system and proper consideration for overhead and general charge expenses, should enable him to start well prepared for prosperous experience. The young man can gain ideas of the efficiency of men by service as a timekeeper or sub-foreman, but will, in the majority of cases, miss many items of cost which do not appear in the field and which are confidential with his employer. It is to supply this lack that these articles will only consider or give actual results on costs other than material and labor.

Waste of Water in Buffalo, N. Y.

By a Special Correspondent.

THE City of Buffalo has the largest pumping station of any city in the world. It is also the most wasteful user of water. These and many other facts were conclusively shown in the recent report of the investigating committee of the Chamber of Commerce and Manufacturers' Club.

The Massachusetts street pumping station, the one which now supplies the city with water, contains four vertical pumps with a capacity of 30,000,000 gallons each; two horizontal pumps with a capacity of 20,000,000 gallons each; three electrically driven pumps with a capacity of 25,000,000 gallons, or an aggregate of 235,000,000 gallons per twenty-four hours. There is no pumping station in the world which has an equal pumping capacity.

According to the report of the water bureau for the year ending June 30, 1910, by steam and electricity, there were pumped 50,847,621,780 gallons of water, or a daily average of 139,308,552, or a per capita consumption of 328 gallons per day. This shows the city to be the most wasteful user of water in the world, a record which is especially unenviable inasmuch as every gallon of water has to be pumped.

All but one of the daily papers and many of the citizens refer to this wasteful use of water with boastful pride and say, "Why shouldn't we use as much, or more if we want to, when we have an inexhaustible supply right at our door?" On the other hand, there are many citizens besides several organizations, including the Chamber, who take the opposite view and believe that this enormous per capita consumption could be cut two-thirds at a large saving to the city and without impairing the health of the city nor unduly stinting the individual.

For nearly two years the city has been in an uproar over this and equally important questions relating to the administration of the water bureau. This discussion was precipitated by an investigation by a committee of the Chamber of Commerce, the object of which was, primarily, to prove that a duplicate pumping station was not necessary at this time; that the present pumping station and equipment was wholly adequate for present needs and for twenty-five years to come.

The Chamber has proceeded in a thorough and businesslike manner, employing legal, accounting and engineering talent of unquestioned ability. Dr. W. R. Patterson, formerly with Haskins and Sells of New York City, who had been employed by the Bureau of Municipal Research in its exhaustive work among the departments in New York City, was employed as an expert accountant. George H. Benzenberg of Milwaukee, Major Cassius M. Gillette, formerly Chief Engineer of the city of Philadelphia; Henry Japp and Ernest P. Goodrich of New York City, and Charles C. Hopkins, formerly New York State expert examiner for the Civil Service Commission in engineering, were employed as experts in the matters of engineering.

After many months of careful work, endeavoring at all times to put the best construction on the methods pursued by the various departments under discussion and at the same time to bring out the facts without fear or favor, the committee has made a report as to its findings, as follows:

"There is no uniform method of accounting. Each department keeps its books in its own way, resulting in much confusion, inaccuracy, needless expense and the practical impossibility of ascertaining the actual and contingent assets and liabilities of the city, or the cost per annum of the operations of important subdivisions of department work.

"Money obtained from the sale of long time bonds issued for permanent improvements has been diverted to maintenance accounts under misleading headings, in an apparent increase in the cost of the water works and deceiving the taxpayers as to the cost of operating the Bureau of Water.

"Purchases in excess of $500 without advertising for bids are frequently made and are covered by two or more orders, given sometimes on the same day, for parts of the same thing. This is a technical evasion of the charter by the use of the "split voucher," a pernicious and evil practice.

"The city pays a higher price for supplies than is consistent with sound management. It should purchase all supplies through a duly authorized agent with due regard to economy.

"The recommendations of the Commission of Engineers, employed by the city prior to this investigation have been disregarded in so many particulars that the cost, up to date and contemplated work, has amounted to more than double the original estimate. The approximate estimated cost of the entire new water works, exclusive of the purchase of one

25,000,000-gallon electric pump and the rebuilding of the old station and repairs to boilers, pumps, machinery, etc., was as follows:

ESTIMATE OF COMMISSION OF ENGINEERS.

Intake tunnel, shafts, conduits, etc	$ 900,000.00
Porter avenue pumping station with equipment	900,000.00
Changes in force mains and valves at present station.	50,000.00
New large water mains	800,000.00
High-service reservoir	50,000.00
Contingencies, etc	100,000.00
	$2,800,000.00

"The contrast between the above estimate with the following statement of the actual and proposed expenditures is too great to be reconciled with wise and economic management:

Intake tunnel, shafts etc	$1,528,296.25
New Porter avenue pumping station with proposed equipment	1,518,434.58
New large main and pipe extension	1,225,972.07
High-service water tower (Kensington water tower).	63,315.04
Rebuilding and equipment of old pumping station	937,341.80
Total	$5,273,359.84
From this certain minor reductions should be made amounting to	4,562.58
Leaving the actual total cost	$5,268,797.26

"The last-named total does not include the proceeds of the old bond issue for $500,000, which was expended partly upon pipe extension and partly upon the station. Nor does it include the proposal to lay twenty-one miles of water mains at an estimated cost of $1,500,000. The result is that if no economies can be effected by changes in the plant at this date, the city will have spent on its new water works and extension of the old, the sum of $7,268,979.26, instead of the $2,800,000, which it was led to believe would be the cost.

"Although the original estimate of the Commission of Engineers provided only for an expenditure of $50,000 on the old pumping station, it has been rebuilt from the foundation up, and with the installation of the pumps already purchased for it, and added to the present capacity of 235,000,000 gallons, will make the enormous daily pumping capacity of 255,000,000 gallons.

"As rebuilt, the old station is a fireproof structure, equipped with modern machinery, insuring high efficiency in operation. It is isolated, with no exposure hazard to fire. As it is located between the railway tracks and the river it has been claimed that a train wreck might occur and the locomotive and cars might crash into the new station, putting it out of commission. Such an occurrence is a physical impossibility, because the pumping station is located on the inner arc of the curve in the railroad at that point, and any accident to a moving train would throw it away from the station rather than into it.

"The present population of Buffalo is 423,715. Allowing for a larger annual increase in the population, and placing two pumps—one of 25,000,000 and the other of 30,000,000 gallons capacity, or a total of 55,000,000—in reserve, the station would have a working capacity of 200,000,000 gallons per day. At the present per capita daily consumption, 323 gallons, the old pumping station as now rebuilt and re-equipped, would furnish an adequate water supply for a population of 615,000, or nearly 200,000 more than the population of the city today."

If the water supply was metered, as in many other cities, the present pumping station would be able to furnish an abundant supply for 1,600,000 people. To show the sharp contrast between a metered and an unmetered water supply, the following in quoted from an editorial in the Live Wire for February, 1911, the official organ of the Chamber of Commerce:

"On Sunday, January 15 (1911), the available pumping capacity consisted of four vertical pumps, each with a capacity of 30,000,000 gallons; two horizontal pumps, each with a capacity of 20,000,000; three electrically driven pumps, each with a capacity of 25,000,000, making an aggregate of 235,000,000 gallons per twenty-four hours. On that date, at the time of my visit, the four vertical and two horizontal steam pumps were being used and one electrically driven pump, or an aggregate pumping capacity of 185,000,000 gallons per twenty-four hours. Whether all these pumps were used for the full twenty-four hours, or worked to their full capacity or not, I am unable to say, as I have not been able to consult the records subsequently. On that day there was held in reserve a pumpage capacity of 50,000,000 gallons.

"On the same day in the city of Cleveland all its water was pumped from the Kirtland pumping station. Two pumps were used, each with a capacity of 25,000,000, or a total of 50,000,000 gallons. The Venturi meters on the discharge mains showed the actual total pumpage for that day to be 44,600,000 gallons.

"The fact that the city of Cleveland has a population of 560,663, and Buffalo 423,715, coupled with the fact that Cleveland obtains its supply from the same

source, not only makes the foregoing statement the more significant, but proves beyond any question of doubt that the city of Buffalo is simply wasting its water and thereby confirms the repeated statements of the Bureau of Water of Buffalo."

In its investigation the Chamber became thoroughly convinced that the installation of meters on the domestic, as well as the manufacturing services was the one policy to pursue as a means of preventing the waste of water. Commissioner Francis G. Ward, on January 11, 1905, sent the following communication to the president of the Common Council, which shows that Mr. Ward was then in harmony with the recommendations of the Chamber of Commerce:

"Hon. Thomas Stoddart, Acting Mayor,
Buffalo, N. Y.

"Dear Sir:—For twenty-four hours, ending A. M. of January 11th, there were pumped 164,509,560 gallons.

"The capacity of the pumping station is 187,000,000 gallons of water per twenty-four hours. No. 5 pump being disabled reduced the capacity to 167,000,000 gallons. The danger of wrecking the pumps when the ice was running caused them to shut down more or less during the twenty-four hours ending 7 A. M. January 10th.

"Assuming the population of Buffalo to be 400,000, according to all well-known standards, 100 gallons per capita per day is considered a liberal supply. This would require 40,000,000 gallons per twenty-four hours and when the so-called water famine, as announced by the press, existed, we had pumped over three times this quantity. The remedy:

"First, change inlet pier to Horse Shoe Reef and construct tunnel from same at present station—cost estimated, $300,000—as free and clear water can always be obtained at this point—a record of twenty years shows this conclusively. The present location of the inlet pier, in the neck of the river, is the worst in the vicinity of Buffalo, from the standpoint of ice conditions and pure lake water.

"Second, means to be taken to prevent the present wasteful use of water by consumers, which can only be stopped by meters.

"Time required, four to six years.

"Consumers, 70,000.

"Average cost of meters, $10.00 each; total cost, $700,000.

"Respectfully yours,
"Francis G. Ward, Commissioner."

From present indications it would seem that Buffalo would continue in the black list column, as the most wasteful city in the world, because the Chamber of Commerce seems to have gotten "cold feet" immediately after issuing its report. Whether the fact that the entire directorate was served in a $50,000 libel suit, brought in the name of two of Mr. Ward's subordinates, has caused a complete silence on the part of the Chamber or not, does not yet appear. The fact that the entire Water Bureau of Buffalo needs a thorough house cleaning is proven by the report of the Chamber of Commerce.

Investigations of Water Waste in Memphis, Tenn.

Report by Carl E. Davis, Resident Engineer of Water Department.

LATE in 1909, on recommendation of the Chairman, the Board of Water Commissioners of Memphis decided to make a study of water wastes of various kinds with a view to their prevention.

Population statistics were gathered during the winter and actual measurements begun in April under the direction of the engineering department.

METHOD OF INVESTIGATION.

The method employed is what is known as the Deacon system, which has been long used abroad, and in detail is as follows:

When the area to be investigated is defined a complete list of all the connections, metered and unmetered, in the district is obtained from the records kept by the department. The amount of water passing through each meter is obtained from the meter department, and from the census taken by this division the number of persons supplied by each connection is obtained. From these data the average per capita metered consumption is computed.

While the record for the district is being compiled all the valves in the district are inspected and those not in good condition are reported to the street department for repairs.

When this preliminary work is finished the valves along the boundary of the district are closed; a pitometer is installed on the supply main feeding the district and the water consumed by the district is measured for a period of about seven days. From this test the average daily consumption and the consumption during the night, when the use of water is low, is determined.

If the amount of water consumed is abnormal the district is subdivided and the consumption of each subdivision measured. The subdivisions showing abnormal rates are selected and tested as follows:

A pitometer is put in operation on a supply main feeding the sub-district, with the boundary valves closed. The area is then narrowed down in successive steps by closing the interior valves and opening the boundary valves. In this manner sections are cut off until the smallest division is reached. As each section is cut off a simultaneous drop in the flow is indicated by the pitometer. The drop or amount of decrease in the flow is the volume of water used by the portion cut off. By this means the unaccounted for consumption is located between valves. These tests are made between the hours of 1 and 5 a. m., for, at that time, the consumption is at a minimum and the rate of flow usually nearly constant.

The sections using the unaccounted for amount are inspected by testing out each connection with the water phone. This enables the inspector to detect any leaks, whether in fixtures or in the service pipe below the surface. He is also, very often, able to detect leaks in the main in the vicinity of the connection being inspected.

Where leaks are found within property lines the owners are given notice to make repairs. Other leaks located are reported to the street department. After repairs are made the sub-district is again tested at night, and if the unaccounted for consumption is still large enough to justify it, the main is uncovered in different places until the source of waste is located.

After each sub-district is tested in this manner and all leaks that can be located are repaired, the consumption of the entire district is again measured for a period of several days to determine the amount of water saved.

SOURCES OF LEAKAGE.

The principal sources of leakage found may be briefly described as follows: Wrought iron pipe supplies; service pipes; house fixtures; fire hydrants; flush tanks.

It was apparent soon after the beginning of the work of inspection that the flush tanks were, in almost every instance, wasting water, some more than others. After the inspection of the first six districts the department decided to have all the tanks in the city inspected at once, and employed men for that purpose, under the direction of the secretary of the department. Up to this time 67 flush tanks have been inspected by the pitometer division, of which 9 were found discontinued and the remaining 58 wasting 106,000 gallons per day, an average of 1,827 gallons per day per tank. If the remaining 307 operating tanks in the city are wasting water at the same rate, repairing them would make a saving of 561,000 gallons per day.

While the inspection of these tanks was not made by the pitometer division, the necessity for it was shown by previous inspection made by this division.

The mains were found in good condition, all the leaks located in them being joint leaks. In most cases these leaks were caused by the jarring of street cars.

The following report shows in detail the work done in each district and its results.

DISTRICT NO. 1.

This district is bounded on the north by the north line of Chelsea avenue, on the east by the east line of Seventh street, on the south by the north line of Auction avenue, and on the west by the east line of Second street. The mains on Keel and Looney avenues lying west of Second street are also included.

Along the north and east sides is a first-class residential district. That part lying west of Second street is a manufacturing district. The remainder is occupied by a thrifty population that, as a rule, own the property on which they live, and consequently the plumbing was generally found to be in good repair. The area covers 134 acres and contains 4.5 miles of mains, and has a population of 3,862; of these, 2,742 are white and 1,120 are black.

Metered Consumption. — The metered population is 1,809, and the average daily consumption is 50,457 gallons, or 28 gallons per capita. Of the number on metered supplies there are 1,190 whites and 619 blacks. The average daily consumption of the whites is 33.2 gallons and of the blacks 17.6 gallons per capita.

Total Consumption.—The consumption was measured from April 15th to April 21st, inclusive, and the average rate of 274,000 gallons per day obtained. The average minimum rate was 172,000 gallons per day, or 63 per cent of the daily rate of supply. The average daily rate of consumption per capita for the entire district was 71 gallons, and the unmetered consumption. 108 gallons per capita per day.

Inspection.—The district has 459 house connections and 11 flush tanks, all of which were inspected. In the inspection of the house connections 15 stop boxes were found filled and were dug up and cleaned out.

Of the 11 flush tanks, 3 were not operating and 8 were wasting 13,000 gallons per day. The leaks found were as follows: 10 property leaks; 7 leaks in supply pipes in the streets; 3 leaking fire hydrants; 2 leaking valves.

Where property leaks were found the owners were given notice to make repairs. Other sources of waste were reported to the street department for repairs.

Resurvey.—After repairs were made another test was made on the district, and a daily consumption of 239,000 gallons per day was shown. This shows a reduction of 35,000 gallons per day, or 13 per cent. of the original consumption. The consumption for the entire district is now 62 gallons per capita per day, the metered 28 gallons per capita per day, and the unmetered 91 gallons per capita per day. The unmetered supply includes water used for sprinkling streets, flush tanks, watering troughs, etc.

DISTRICT NO. 2.

This district is bounded on the north by Chelsea and Vollentine avenues, on the east by Cypress Creek, on the south by Jackson avenue, and on the west by Seventh street. It is almost entirely occupied by middle-class residences, with a few small suburban stores. The area is 344 acres, and has 10.4 miles of mains. The population is 5,836, 4,764 whites and 1,072 blacks.

Metered Supply.—The metered supply from records of the meter department for 1909 for this district was 54,294 gallons per day. The metered population is 2,836 and the average daily consumption is 19.1 gallons per capita. Of the metered population, 2,058 are white and 778 black. The average daily consumption of the white is 21 gallons and of the blacks 14.2 gallons per capita.

Total Consumption.—The first test for total consumption was made from May 10th to May 20th, 1910, inclusive, and the average found to be 470,000 gallons per day. The average minimum night rate was 319,000 gallons per day, or 68 per cent. of the daily rate of supply. The average daily consumption per capita for the entire district was 81 gallons and the unmetered consumption 138 gallons per day per capita.

Inspection.—In this district there were 864 house connections and 14 flush tanks inspected. In the inspection of the house connections 39 stop boxes were found filled and were dug up and cleaned out. Of the 14 flush tanks, 5 were in good condition and 9 were wasting 23,500 gallons. Other sources of waste found were:

14 property leaks. (Owners were given notice to make repairs.)

12 leaking supply pipes in the streets.

1 leak in main corner of Oak street and Chelsea avenue, wasting 15,000 gallons per day. This leak had blown a hole in the joint of a drain pipe and was discharging directly into it.

1 leak in main corner of Argyle street and Chelsea avenue.

2 leaks in wrought iron supply pipe in Short Saffarans street.

5 fire hydrants.

3 valves.

All leaks except those on private property were reported to the street department for repairs.

Resurvey.—After these wastes were repaired the consumption of the district was again measured and an average rate of 394,000 gallons per day obtained. This shows a reduction of 76,000 gallons per day, or 16 per cent. of the original consumption. The average per capita consumption now is 67.6 gallons per day. The metered consumption is 19.1 gallons and the unmetered consumption 113 gallons per capita per day.

DISTRICT NO. 3.

This district is bounded on the north by Auction avenue, on the east by Maiden Lane as far south as Jackson avenue, and from there to Washington avenue; the eastern boundary is Court House alley. It is bounded on the south by the south line of Washington avenue, and on the west by Front street, but does not include the 36-inch main on Front street. This is largely a business district, but it also contains a number of low-class tenements. Its area is 112 acres, and has 2.8 miles of mains. As it is a business section, its population is a shifting one, and could not be accurately enumerated. Most of the services are, however, metered, there being 1,348 people on flat rate services.

Metered Consumption. — The average daily metered consumption for 1909 was 96,337 gallons.

Total Consumption.—The total consumption of the district was measured from June 20th to June 28th, inclusive, and found to be 358,000 gallons per day. The average minimum night rate was 248,000 gallons per day, or 69 per cent. of the average daily rate of supply.

Inspection.—All connections, both metered and flat rate, numbering 502, were inspected; also 5 fire cisterns and 10 flush tanks. The connections to the fire cisterns were found in good condition. Of the flush tanks, 4 were found discontinued. In inspecting the house connections, 43 stop boxes were found to be filled and reported to the street department to be cleaned out.

Leaks were found as follows:

5 underground property leaks. (Owners given notice to make repairs.)

5 connections with leaking fixtures. (Owners given notice to repair.)

2 leaks in supply pipes in the streets.

3 fire hydrants.

1 leaking valve.

6 flush tanks wasting 9,000 gallons per day.

All sources of waste other than those on private property were reported to the street department for repairs.

Resurvey.—After repairs were made the consumption of the district was again

measured and an average daily rate of 292,000 gallons obtained, which indicates a saving of 66,000 gallons per day, or 18 per cent. of the original daily consumption of the district.

DISTRICT NO. 4.

District No. 4 is bounded on the north by Vollentine avenue, on the east by Manassas street, on the south by Chelsea avenue, and on the west by Second street. It also includes the 20-inch main on Second street from Jackson avenue north and all the mains lying west of Second street north of Chelsea avenue, and the 4-inch main on Park street north of Vollentine avenue. The northern and western parts are occupied by saw mills and lumber yards; the remainder is occupied by a good class of suburban residences. The area is 205 acres, containing 5.5 miles of mains and a population of 4,664, of which 3,717 are white and 947 are black.

Metered Consumption. — The metered population is 2,689; of these 1,977 are white and 712 black. The total average daily metered consumption is 39,740 gallons per day. The average consumption per capita per day is 148 gallons. The whites on an average use 16 gallons per capita per day and the blacks 11.7 gallons.

Total Consumption.—The consumption of the entire district was measured from July 21st to July 25th, and the average daily consumption was found to be 316,000 gallons, a per capita consumption of 58 gallons per day. The average minimum night rate was 156,000 gallons, or 49 per cent. of the daily rate.

The unmetered population is 1,975, with consumption of 139 gallons per day per capita.

Inspection.—In inspecting this district 586 house connections were tested and all flush tanks (4 in number) were examined. The following sources of waste were found:

16 underground leaks in supply pipes in the streets.

7 property leaks. (Owners given notice to make repairs.)

2 leaking fire hydrants.

1 leaking valve.

4 flush tanks wasting 10,500 gallons per day.

In inspecting house connections 37 stop boxes were found stopped up and were taken out and cleaned.

Resurvey.—The final test of the entire district, after repairs were made, showed a minimum rate of consumption of 53,000 gallons per day, a reduction of 103,000 gallons per day, or 32 per cent. of the original consumption. This reduces the daily consumption per capita to 45 gallons and the unmetered consumption to 90 gallons per capita per day.

DISTRICT NO. 5.

This district is bounded on the north by the south line of Lane avenue, on the east by the west line of Decatur street, on the south by the north line of Poplar avenue, and on the west by the east line of Manassas street. Its area is 115 acres and has a population of 2,538, and contains 2.5 miles of mains. It is mostly a colored tenement house district, and contains 342 whites and 2,196 blacks.

Metered Consumption. — The metered population is 1,036, of which 174 are white and 862 black. The average daily consumption is 23,920 gallons, or 23 gallons per capita per day. The average consumption of the whites is 48 gallons per capita per day, and of the blacks 18 gallons.

Total Consumption.—The total supply was measured for a period of five days, from August 14th to August 18th, inclusive, and showed an average daily flow of 185,000 gallons, with an average minimum night rate of 147,000 gallons per day, which was 79 per cent. of the average daily rate. The average daily rate of consumption per capita was 73 gallons. The unmetered consumption was 107 gallons per capita per day.

Inspection.—This district has 389 house connections and 4 flush tanks. In the inspection of the house connections, 26 stop boxes were found stopped up and were cleaned out. Of the 4 flush tanks, 2 were not operating.

Leaks were found as follows:

15 property leaks. (Owners given notice to make repairs.)

8 leaks in supply pipes in the streets.

1 leaking fire hydrant.

2 leaking valves.

2 flush tanks wasting 30,000 gallons per day.

Leaks not on private property were reported to street department for repairs.

Resurvey.—The minimum night rate after repairs was made was 66,000 gallons per day. This shows a reduction in consumption in the district of 81,000 gallons per day, or 43 per cent. of the original supply. The average consumption for the district was reduced to 40 gallons per capita per day, and the unmetered consumption to 54 gallons per capita per day.

DISTRICT NO. 6.

This district lies between Jackson avenue, Poplar avenue and the east line of Manassas street, and also includes the Lane avenue main and its branches on the north side as far east as Ayres street. The northern and eastern sections are covered by a poor class of rental property, the southern and western sections by a good class of residences. The area covers 170 acres and has 5.8 miles of mains and a population of 5,423, of which 3,939 are white and 1,484 are black.

Metered Consumption. — The metered population is 2,448, and the average daily consumption of 53,856 gallons, or 22 gal-

lons per capita. Of the number on metered supplies, there are 1,429 whites and 1,019 blacks. The average daily consumption of the whites is 25 gallons, and of the blacks 18 gallons per capita.

Total Consumption.—The total consumption was measured from October 10th to October 15th. The average daily flow during this test was 300,500 gallons, with a minimum night rate of 122,500 gallons per day, which is 47 per cent. of the average daily consumption. The total average consumption per capita was 55 gallons per day, and the unmetered consumption 82 gallons per capita per day.

Inspection.—The house connections, 855 in number, 24 flush tanks and 2 fire cisters were inspected. Of the flush tanks, 6 were found in bad condition and wasting 20,000 gallons per day.

Other sources of waste were:

12 leaking fixtures.
7 leaks in supply pipes in streets.
3 leaks in fire hydrants.
2 leaks in valves.
1 leak in the main on High street.

During this inspection 156 stop boxes were found to be filled and were either cleaned out or reported to the street department to be cleaned.

After repairs were made the consumption of the district was again measured, the result of which shows that some new sources of waste had developed since the previous test that brought the consumption up to an amount practically equal to the original.

Another inspection was made and the following leaks were found:

16 leaking fixtures.
4 leaks in supply pipes in the streets.
5 leaking fire hydrants.
4 leaks in mains.

After repairing these leaks a test of the district showed that the daily consumption had increased instead of being decreased. A third inspection was made and 16 leaking fixtures found. The repairing of these leaks did not reduce the consumption and a final test of the district showed an everage daily consumption of 344,000 gallons per day, with a minimum night rate of 250,000 gallons per day, which is 73 per cent. of the average daily rate.

The consumption of the water during the night is not confined to any locality, but spread over the entire district. The temperature at the time of this test was low, and the waste may have been caused by water being allowed to run to prevent freezing of fixtures. This district will be worked over again when the weather becomes suitable.

Total number of leaks found:

44 places with leaking fixtures.
11 leaks in supply pipes in the streets.
5 leaks in mains.
8 leaks in fire hydrants.
2 leaks in valves.
6 leaks in flush tanks.

Resurvey.—The saving of waste in this district that could be measured was the 20,000 gallons per day in the flush tanks, 5,000 gallons per day in 3 fixtures on Jones avenue, and 15,000 gallons per day in a leak in the main on High street, making a total of 40,000 gallons per day. If there had been any way to measure the amount saved by repairing other leaks this amount would have been considerably larger.

DISTRICT NO. 7.

This district is bounded on the north by the south line of Washington avenue, on the east by the east line of Court House alley, on the south by the north line of Union avenue, and extends west to the Mississippi river, but does not include the 36-inch main on Front street. The area covers 90 acres and has 3.4 miles of mains. Being a business district, the population is a shifting one and could not be enumerated. There are 477 connections, of which 369 have meters and 108 are unmetered. The population on unmetered supplies is 429. Among the unmetered supplies there are 12 connections to business houses where there was no way of getting at the amount of water consumed.

Metered Consumption.—The average daily metered consumption is 468,000 gallons. The fountain in Court Square uses, according to pitometer measurement, 27,000 gallons per day, and 3 flush tanks use 1,500 gallons per day, making a total of 496,500 gallons per day.

Total Consumption.—The consumption of the district was measured for a period of 7 days, from October 21st to October 27th, inclusive, and the daily average found to be 623,000 gallons. The average minimum night rate was 291,000 gallons per day, or 49 per cent. of the daily rate. Allowing 26,000 gallons per day (60 gallons per capita) for the unmetered population, the accounted for daily consumption is 422,500 gallons, leaving 100,000 gallons per day unaccounted for. From this 100,000 gallons is to be deducted the amount used by the 12 flat rate connections mentioned above, and also the water used for street flushing.

Inspection.—The seven flush tanks in the district were inspected and 4 found to be discontinued. The three that were operating were in good condition.

The district was carefully tested to locate any section that might be using an unusual quantity of water at night. During the night tests the street connections were inspected. The water used at night was all traced to connections, with a few exceptions, which amounted to very little. During the inspection 2 leaks in valves and 2 leaks in supply pipes, aggregating 3,000 gallons per day, were reported to the street department for repairs.

TABLE SHOWING RESULTS OF WASTE WATER INSPECTION BY PITOMETER DIVISION, CITY OF MEMPHIS, 1910.

	District Number.	1	2	3	4	5	6	7	Totals
1	Area in acres	134	344	112	205	115	170	90	1,170
2	Metered population	1,809	2,836	.....	2,689	1,036	2,448	.....	.....
3	Unmetered population	2,053	3,000	1,348	1,975	1,502	2,975	429	.....
4	Total population	3,862	5,836	.....	4,664	2,538	5,423	.....	.....
5	Metered supply ....gallons per day.	50,457	54,294	96,337	39,740	23,920	53,856	500,080	818,684
6	Unmetered supply ....gallons per day.	223,543	415,706	261,663	276,260	161,080	246,644	122,920	1,707,816
7	Total supply ....gallons per day.	274,000	470,000	358,000	316,000	185,000	300,500	623,000	2,526,500
8	Metered consumption per capita....gallons per day.	28	19.1	.....	14.8	23	22	.....	.....
9	Unmetered consumption ....gallons per day.	108	138	.....	139	107	82	.....	.....
10	Miles of mains	4.5	10.4	2.8	5.5	2.5	5.8	3.4	34.9
11	Number of connections	459	864	503	586	389	855	477	4,132
12	Property leaks	10	14	10	23	15	44	.....	116
13	Leaky supply pipes	7	14	2	.....	8	11	2	44
14	Leaks in mains	.....	2	.....	.....	.....	5	.....	7
15	Leaking valves	2	3	1	1	2	2	2	13
16	Leaking fire hydrants	3	5	3	2	.....	8	.....	21
17	Leaking flush tanks	8	9	6	4	2	6	.....	35
18	Total number of leaks	30	47	22	30	27	76	4	236
19	Number of stop boxes cleaned out	15	39	43	37	26	156	1	317
20	Number of connections inspected	459	864	502	586	389	855	235	3,890
21	Number of flush tanks inspected	11	14	10	4	4	24	7	74
22	Consumption per capita before inspection (gallons per day)	71	81	.....	68	73	55	.....	.....
23	Consumption per capita after inspection (gallons per day)	62	67.6	.....	45	40	.....	.....	.....
24	Total consumption after making repairs	239,000	394,000	292,000	213,000	104,000	.....	.....	.....
25	Reduction in consumption	35,000	76,000	66,000	103,000	81,000	40,000	3,000	404,000
26	Percentage of original consumption saved	13	16	18	32	43	13.3	5	16

The waste in the district was so small, as shown by 84 per cent. of the total consumption being actually accounted for with the supply to the 12 connections already mentioned and the water for street flushing to be deducted from the remaining 16 per cent., it was decided that it would not be economical to attempt to locate it.

The amount charged against the pitometer work for the year 1910 was $4,251.82, which included the cost of tools and the expenses of gathering census statistics, of which there are enough on hand for the coming year's work.

Valuing the water saved at $40.00 per 1,000,000 gallons, the amount saved for the year is approximately $5,900.00, a saving of $1,648.18 for the year. With a slight increase in the force, the pitometer can be worked much more efficiently, thereby decreasing the cost of the survey for the coming year per thousand gallons.

Taking the results of the work done during the year 1910 as a basis for an estimate, it shows that there is in that part of the city not yet tested a leakage of approximately 2,500,000 gallons per day that can be eliminated.

While the consumption of the city is not large, as compared with other cities, that it is excessive is readily borne out by the fact that in 1909 the total pumpage for the city was 5,116,855,804 gallons, of which 1,228,625,250 gallons passed through meters, leaving 3,888,230,554 gallons to be used through flat rate connections. It is estimated that the city of Memphis was furnished, free of charge, approximately 365,000,000 gallons, which leaves 3,523,230,554 gallons to be either wasted or used by the flat rate consumers. At that time 40 per cent. of all connections were metered, thus leaving 60 per cent. of the connections to use 74 per cent. of the water supplied to private consumers.

In 1909 the income from the 1,228,625,250 gallons sold through meters was $221,361.44 or 18 cents per 1,000 gallons, while from 4,751,855,804 gallons used by flat rate consumers the income was $138,712.95, or 2.9 cents per 1,000 gallons. Where the waste is due to carelessness it can be prevented by the installation of meters; but other sources of waste can only be eliminated by careful inspections.

Standard Tests for Bituminous Road Materials.

Report of Committee of American Society for Testing Materials—Logan Walter Page, Chairman.

DURING the past year the Committee on Standard Tests for Road Materials of the American Society for Testing Materials has worked along the lines planned at the last annual meeting, which were described in its report for 1910. A number of the special committees on Bituminous Paving Materials have done valuable work in investigating existing methods and devising new methods for the examination of such materials. The reports of these special committees have been considered by the main committee which recommended the following four methods for adoption as provisional by the Society: 1. Proposed provisional method for the determination of soluble bitumen. 2. Proposed provisional method for the determination of the penetration of bitumen. 3. Proposed provisional method for the determination of the loss on heating of oil and asphaltic compounds. 4. Proposed provisional method for sizing and separating the aggregate in asphalt paving mixtures.

The Committee in presenting the proposed provisional method for the determination of soluble bitumen, did not recommend it as the best for general use, as it is longer and in many cases gives no better results than other more expeditious methods, but only as a method to be resorted to in case of dispute, as it seems to have the widest range of applicability of any of the methods considered. Moreover, they stated that with some classes of materials this method will show a lower percentage of soluble bitumen than many of the shorter methods.

The Committee also stated that no great degree of refinement is to be expected from the proposed provisional method for the determination of the loss on heating of oil and asphaltic compound, owing to the fact that no absolutely satisfactory standard oven has yet been found. This matter will be given careful attention during the coming year and it is hoped that an oven will be found or developed which will be an improvement over the one at present recommended.

The proposed provisional methods above mentioned are to be voted on by letter ballot, by the members of the Society. The methods are as follows:

Proposed Provisional Method for the Determination of Soluble Bitumen.

DRYING THE SAMPLE AND PREPARING IT FOR ANALYSIS.

It was decided, owing to the great variety of conditions met with in bituminous compounds, that it is impossible to specify any one method of drying that would be satisfactory in every case. It is therefore supposed that the material for analysis has been previously dried, either in the laboratory or in the process of refining or manufacture, and that water, if present, exists only as moisture in the hydroscopic form.

The material to be analyzed, if hard and brittle, is ground and spread in a thin layer in a suitable dish (iron or nickel will answer every purpose) and kept at a temperature of 125 degrees C. for one hour. In the case of paving mixtures and road materials, where it is not desirable to crush the rock or sand grains, a lump may be placed in the drying oven until it is thoroughly heated through, when it can be crushed down into a thin layer and dried as above. If the material under examination contains any hydrocarbons at all volatile at this temperature, it will of course be necessary to resort to other means of drying. Tar or oils may be dehydrated by distillation and the water-free distillate returned to the residue and thoroughly incorporated with it.

ANALYSIS OF SAMPLE.

After drying, from 2 to 15 grams (as may be necessary to insure the presence of 1 to 2 grams of pure bitumen) is weighed into a 150 C. C. tared Erlenmeyer flask, and treated with 100 c. c. of carbon disulphide. The flask is then loosely corked and shaken from time to time until all large particles of the material have been broken up. It is then set aside for forty-eight hours to settle. The solution is decanted into a similar flask that has been previously weighed. As much of the solvent is poured off as possible without disturbing the residue. The contents of the first flask are again treated with fresh carbon disulphide, shaken as before, and then put away with the second flask for forty-eight hours to settle.

The liquid in the second flask is then carefully decanted upon a weighed Gooch crucible 3.2 c. m. in diameter at the bottom, fitted with an asbestos filter, and the contents of the first flask are similarly treated. The asbestos filter is made of ignited long-fibre amphibole, packed in the bottom of a Gooch crucible to the depth of not over one-eighth inch. In filtering no vacuum is to be used and the temperature is to be kept between 20 degrees and 25 degrees C. After passing the liquid contents of both flasks through the filter, the residue on the filter is thoroughly washed and the residues remaining in them are shaken with more fresh carbon disulphide and allowed to settle for twenty-four hours, or until it is seen that a good subsidation has taken place. The solvent in both flasks is then again decanted through the filter and the residues remaining in them are washed until the washings are practically colorless. All washings are to be passed through the Gooch crucible.

The crucible and both flasks are then dried at 125 degrees C. and weighed. The filtrate containing the bitumen is evaporated, the bituminous residue burnt, and the weight of the ash thus obtained added to that of the residue in the two flasks and the crucible. The sum of these weights, deducted from the weight of substance taken, gives the weight of soluble bitumen.

Proposed Provisional Method for the Determination of the Penetration of Bitumen.

The penetration of bitumen shall be the distance expressed in .01 cm. that a No. 2 needle will penetrate into it vertically without friction at 25 degrees C. under a stated weight applied for a stated length of time, the factors of weight and time being determined as follows:

The material shall first be tested for five seconds under a weight of 100 grams. If this result is less than 10, the penetration shall be determined under a weight of 200 grams applied for one minute; if between 10 and 300, the penetration shall be determined under a weight of 100 grams applied for five seconds; if greater than 300, the penetration shall be determined under a weight of 50 grams applied for five seconds. In every case the factor of weight and time shall be stated when reporting the penetration and whenever possible to obtain both readings, the penetration under a 100 gram weight for five seconds and under the modified weight and time shall be reported. When testing material softer than 100 penetration, a containing receptacle not less than 1¼ inch in diameter shall be used.

It is recommended that the penetration may be determined at 0 degree C. (32 degrees F.) and 46 degrees C. (114.8 degrees F.) in addition to the 25 degrees C. (77 degrees F.) test.

Proposed Provisional Method for the Determination of the Loss on Heating of Oil and Asphaltic Compounds.

The loss on heating of oil and asphaltic compounds shall be determined in the following manner: 20 grams of the water-free material shall be placed in a circular tin box with vertical sides, measuring about 2 cm. in depth by 6 cms. in diam-

eter, internal measurement. The penetration of the material to be examined shall, if possible, be determined at 25 degrees C. and the exact weight of the sample ascertained. The sample in the tin box shall then be placed in a hot air oven (New York Testing Laboratory Oven without fan), heated to 163 degrees C. (325 degrees F.) and kept at this temperature for five hours. At no time shall the temperature of this oven vary more than 2 degrees C. from 163 degrees C. When the sample is cooled to normal temperature, it shall be weighed and the percentage of loss by volatilization reported. The penetration of the residue shall then, if possible, be determined at 25 degrees C. as upon the original material, and the loss in penetration found by subtracting this penetration from the penetration before heating. In preparing the residue for the penetration test it shall first be heated and thoroughly stirred while cooling.

Proposed Provisional Method of Sizing and Separating the Aggregate in Asphalt Paving Mixtures.

The method consists of passing the mineral aggregate through several sieves of the following sizes in the order named:

200 meshes per linear inch, 2.54 c.m., size of wire.....0.00235—(0.05969 mm.)
100 meshes per linear inch., 2.54 c.m., size of wire.....0.0045 —(0.1143 mm.)
80 meshes per linear inch, 2.54 c.m., size of wire.....0.00575—(0.14605 mm.)
50 meshes per linear inch, 2.54 c.m., size of wire.....0.009 —(0.2286 mm.)
40 meshes per linear inch, 2.54 c.m., size of wire.....0.01025—(0.26035 mm.)
30 meshes per linear inch, 2.54 c.m., size of wire.....0.01375—(0.34925 mm.)
20 meshes per linear inch, 2.54 c.m., size of wire.....0.0165 —(0.4191 mm.)
10 meshes per linear inch, 2.54 c.m., size of wire.....0.027 —(0.6858 mm.)

Highways in England.

By a Special Correspondent.

AFTER many years of extreme neglect in this country that branch of municipal administration concerned with maintenance and repair of highways is developing in a most gratifying manner. The reason is not far to seek. The increase in vehicular traffic, both as regards weight and volume, has affected every highway authority in the country, and has, in London, reached an acute stage, and given rise to a very difficult and complex problem, which, every year, presses more for a solution. The enormous and rapidly swelling volume of motor traffic, comprising heavy lorries, vans and omnibuses, in addition to the ever-increasing number of motor-cars and cabs, has not only brought home to the public mind the importance and gravity of the question of rapid and efficient road travel, but has evoked no small amount of criticism of the existing methods of road planning and road construction.

Until quite recent years roads were constructed primarily for the use of horse-hauled traffic. Indeed, any great development of mechanical haulage or propulsion was most effectually prevented by the Locomotives Act of 1865. The man with a red flag, who, in accordance with the provisions of this Act, cautiously preceded such mechanically-propelled vehicles as passed down the roads of our boyhood, is to us a comic memory today, and it would be surprising if the road construction practice which served to meet such conditions were found equal to the present demands of the heavy and high-speed traffic rendered possible by the repeal of the 1865 Act in 1896, and in the passing of such subsequent Acts as the Locomotives Act of 1898, the Motor-car Act of 1903, the Heavy Motor-car Order of 1904, etc.

The Road Board was established under the Development and Roads Improvement Act of 1909 with the object of assisting local authorities in improving the roads of the country in various ways, such as widening them, diverting their course, reconstructing and improving the surface, altering awkward and dangerous curves and corners, raising the level and draining them, widening bridges, and so forth. The chairman of the board is Sir George Gibb, so well known in connection with railway administration, and the members comprise Lord Pirrie, K. T.; Lord Kingsburgh, Lord Justice Clerk of Scotland; Lord St. Davids and Sir Charles Rose.

It was stated in November, 1910, that the applications made to the Board already exceeded $27,500,000, a sum far in ex-

cess of the funds available, which are estimated at about $5,500,000 up to the end of the current financial year.

Experts are busily engaged in deciding how to utilize available new materials by new methods at the lowest cost. One essential is recognized to be the proper waterproofing of the road. The most generally accepted systems here are those concerned with either coating with a reliable tar or tar compound or laying the stone dry and cementing it together with a suitable compound poured into the joints of the stone.

In both these systems the consolidation of the surface by careful rolling so as to ensure a compact watertight road is most important. The cost of these systems is still a matter of considerable discussion.

British engineers and surveyors readily recognize the new methods, but are too often handicapped by having to base their calculations of the cost of tar-macadam on small experiments (hand mixing) carried out at their councils' depot. Items of cost such as capital charges and administration expenses are sometimes overlooked, with the result that an erroneous idea prevails as to the actual cost of effectively carrying out the work. It will be apparent at once that the unfortunate contractor or merchant has to contend with such erroneous ideas of cost, although as a specialist he may have expended a vast amount of time, trouble and money in order to gain his experience of the best method and materials and to put them on the market. Success can only be achieved by the use of the very best materials, coupled with the full knowledge, only acquired by experience, as to the temperatures of the materials at the time of mixing and the proper mixtures. Undoubtedly the machine that can mix the ingredients in definitely gauged quantities is the most reliable, and a portable machine to do such work at the roadside will naturally reduce the cost of transport.

Such a machine is on the market, with the result that today a suitable granite in conjunction with a reliable tar compound can be converted on the spot into the best tar macadam. This development will enable tar macadam to be used in districts where hitherto the cost of transportation has made it prohibitive.

The system of cementing the dry stone on the road has also to some extent proved itself a fairly reliable and somewhat fully justified by the longer life of the cheaper method. In either case although the initial outlay must be more than in the old system of water-bound roads, it is road and the reduced cost of maintenance, thereby proving the cheapest in the end.

The British Institution of Civil Engineers naturally gives considerable attention to road construction and maintenance and interesting papers are read from time to time on those questions. Among recent interesting views expressed there were those of Walker Smith. He suggests the reconstruction of about fifteen thousand miles of roads in England and Wales upon the principle of spreading the cost over a period of seven years. The net result of this, upon the data assumed, is that the whole of this length of roads would be entirely reconstructed in a period of thirty-four years. At no period would the present cost of maintenance be exceeded, while at the twenty-third year a gross annual saving would commence, increasing until, in the forty-first year, there appears a maximum permanent saving of between $10,000,000 and $15,000,000 per annum.

He also recommends the standardization of materials of construction, and for the accumulation of data for the design of future roads. In the case of standardization, it is suggested that there should be commenced and thereafter continued systematic laboratory tests and analyses of stones, the physical and petrological results of which should be recorded for each trial length of road laid under service conditions. These records are suggested with a view to correlate the various physical tests, and further to correlate the physical tests with the petrological descriptions. It is desired to establish ultimately, at least for physical qualities, relative values of stones for bituminous-bound and water-bound macadam.

There should be laid down three or four standards for the bituminous binder, and the subject should be pursued further in the laboratory. The standards for tar itself would enable a number of tests to be eliminated, and reliance to be placed upon a very few. Further, the effects of blending tar with other substances, such as petroleum residues and asphalt in various proportions, could be ascertained, and also the effect of introducing various proportions of inert matter.

Another road expert speaking at the same institution declares that the first essential condition for successful road construction is a good foundation, and states that to provide a proper foundation for the 27,000 miles of main roads in England and Wales would cost $275,000,000. He refers to the heavy motor-car traffic and the anomalous position of the heavy or commercial motor, which is permitted to have an axle weight of 840 pounds per square inch width tire on a wheel 3-ft. in diameter, while a traction-engine is only allowed a weight of 616 pounds per inch width. He gives examples of the damage caused by these heavy motor-vehicles and suggests that steps should be taken to remedy this state of affairs.

Dust and its Prevention on City Streets.

By Prof. Arthur H. Blanchard, M. Am. Soc. C. E., Consulting Highway Engineer, Providence, R. I.

PUBLIC nuisances shall not be tolerated within the city limits is a phrase to be found on all our municipal statute books and yet repugnant, dirty, dusty streets are characteristic of practically all of our American cities. Why should a people, who spend vast sums of money for public improvements which add to the comfort of mankind, submit to streets covered with dust and dirt of all kinds? One reason is that the large majority of the people of this country do not appreciate that it is economically possible to have clean and practically dustless streets and those who are familiar with cities where clean streets are the rule rather than the exception have not the courage of their convictions to make an emphatic protest to those responsible or to carry the issue to the polls if necessary. The present is an opportune time for vigorously attacking the broad problem of prevention of dust on city streets since it is slowly becoming recognized that clean streets contribute not only to the healthy condition of a city, but also play an important part in attracting capital and desirable residents. One must have a callous mind, indeed, who can drive through the streets of Dresden at any time of the day and not be impressed with the spotless, dustless condition of the streets of that municipality and feel that it is a desirable place in which to live.

Before considering the effects of dust and the methods of alleviating the nuisance caused by its presence a study of the sources from which street dust arises may be of interest. A self-evident source of dust is the mechanical abrasion by traffic of the road or street surface. It is manifest that the degree of abrasion will depend upon the amount and nature of the traffic, the kind of materials used, and the method of construction and maintenance employed. Other sources of street dust depending upon traffic are the deposition of dirt which has adhered to the wheels of vehicles coming from adjacent earth, gravel, or macadam streets, from the leakage of the contents of loaded vehicles, both in transit and while loading and unloading, and from the excrement of animals. All street dust is by no means the result of traffic. In sections where shade trees are common a source of dust is to be found in the decay of twigs, bark and leaves, while pollen, seeds and spores of various plants are further sources. Mineral matter applied to certain street surfaces to prevent slipperiness is a constant source of dust. Dust resulting from manufacturing enterprises frequently forms a very considerable part of street dust. Mills where pulverizing is carried on, textile establishments and foundries are prolific sources of dust, while soot and fine ashes from chimneys find their way to the streets. From the nature of these sources it is apparent that the composition of street dust is extremely varied and complex.

Dust exerts a considerable pathogenic influence aside from its acting as a conveyor of disease germs. Various delicate membranes are irritated by the simple mechanical action of the dust with the result not only of local inconvenience, but many times of general debility. The membranes of the respiratory organs are susceptible to this influence, especially if a person be asthmatic. The membranes of the eye are also frequently seriously irritated by dust. In the sections where the dust problem has been successfully solved physicians report a marked falling off in the number of cases of conjunctivitis.

In considering the problem of dust prevention on city streets it is advisable to classify the public ways under two general heads, business and residential streets, and to further differentiate between residential streets which are narrow, heavily shaded with trees and bordered with residences, and those streets which are more or less open.

There is one way and only one way to satisfactorily prevent dust on bituminous, cement-concrete, brick, wood block and stone block pavements, which are subjected to excessive horse-drawn vehicle traffic. That method consists of removing the dung of animals and other street refuse by hand sweeping during the day, mechanical sweeping of the streets at night, which should be preceded by sprinkling, and finally flushing with water to remove fine dust and thoroughly cleanse the surface of the pavement. Under certain conditions dependent upon the amount and character of traffic and the uses to which the street is subjected it is feasible to omit the mechanical sweeping. It must be realized that it is absolutely impossible to economically remove fine dust by either hand or mechanical sweeping. The use of the so-called dust palliatives and surface treatments on pavements subjected to heavy mixed traffic is entirely wrong in principle, as sanitary conditions require the constant removal of filth from streets and if this

is removed periodically by flushing, the effectiveness of these processes is curtailed. Again, periodical watering of pavements to lay dust throughout the day is fundamentally wrong, as the fine dust which necessitates sprinkling should have been removed.

However, bituminous, cement-concrete, brick and wood block pavements may be used on streets subjected primarily to motor car traffic and light horse-drawn vehicle traffic, such as boulevards, open intra-urban trunk lines, etc. In such cases flushing is not necessarily a prerequisite to cleanliness. Generally patrol hand sweeping throughout the day will be sufficient.

Residential streets may be built with bituminous surfaces or as bituminous pavements dependent upon local conditions. On this class of streets the traffic is usually comparatively light from the standpoint of city traffic. If such streets have a surface coat of the proper kind of asphaltic material the dung of animals and other refuse can be removed by patrol hand sweeping while the nature of the surface will be such as to absorb fine dust and render the street practically dustless.

For macadam streets in poor condition for superficial treatments or when financial conditions do not render expedient the use of surface treatments and patrol sweeping, recourse must be had to the use of palliatives, such as light oils or light tars. To attain successful results it is necessary that light products having the proper chemical and physical properties should be used in small amount periodically during the season of dust.

In slum residential districts the streets, unless subjected to heavy horse-drawn vehicle traffic, should, provided grades will permit, be constructed of waterbound macadam with a superficial coat of refined tar or as bituminous pavements with a seal coat of refined tar. The gradient, however, may require the use of an asphaltic tar compound or an asphalt for the superficial or seal coat. These forms of construction will give a sanitary surface, one from which excess dirt, dung of animals and refuse can easily be removed by patrol hand sweeping and which, during the night, can be thoroughly cleansed by flushing. It should be noted that the nightly flushing with water will add materially to the comfort of the people by perceptible cooling of the atmosphere during hot summer nights.

In closing it is paramount to emphasize the fact that economical and efficient results will only be attained by municipal ownership of the requisite plant equipment and a well-organized force of competent workmen.

Street Sprinkling in Denver, Colo.

ONE of the busiest departments of the Denver city government at this season of the year is the street sprinkling department, the employes of which are on duty two-thirds of the day in their campaign against the dust evil. The present season has been a particularly trying one, and every piece of equipment in the department is being utilized in an egort to keep the dusty streets in a moist condition. More territory is being covered by the sprinklers than ever before.

The department aims to wet the streets in an area aggregating forty square miles from twice to three times daily. The dirt streets are gone over twice a day, morning and afternoon, and the paved streets in the business section during the months of June, July, August and September three times a day. Some of the thoroughfares where traffic is heavy are sprinkled at night, in addition to their twice-daily wetting. The grounds about the City Market are also sprinkled at night so that they will be in a dustless state when the hundreds of wagons loaded with fruit and garden truck arripe during the early morning hours. Denver's area in square miles is a fraction over fifty-nine. The streets and boulevards in all but nineteen square miles are sprinkled by the sprinkling department.

The remaining portion includes the parks, the sprinkling of which is done by the park department, and certain highways that are inaccessible to the sprinkling teams, and also streets that are undergoing grading and other improvements, over which it is impossible to take a sprinkler.

The work of sprinkling is systematized in such a way that nearly every section of the city, except in the cases noted, is receiving its proper share of water daily. The city is divided into ninety-six districts, one for each of the ninety-six sprinkling teams. On the dirt streets the beat of the sprinklers averages twelve blocks twice a day for each team. The sprinkler goes up one side of the street and down the other, making one round trip in the

morning and one in the afternoon. The spray from the wagons reaches eighteen feet, and by going back and forth a thirty-six-foot street can be covered.

The capacity of a Denver sprinkler is 600 gallons. Water is taken from the city hydrants and one load will wet three blocks of streets on one side.

The sprinklers in use in Denver are of the most approved pattern. Most of them are shipped direct from factories at Austin, Ill., and South Bend, Ind. Eight sprinklers have been built at the city shops and more will be constructed there as the shops expand. All repairs are made at these shops.

The men who drive the sprinklers are paid $4.50 a day for eight hours' work, and at the same rate for overtime. They furnish their own teams. However, the city pays only for work actually performed. If there is a rainstorm, necessitating an abolishment of sprinkling for a morning or an afternoon, the drivers are docked for a whole or a half day, as the case may be. They receive their orders either from a bulletin board in front of the department's office at City Hall or by calling headquarters by telephone.

Sprinkling is carried on to some extent during every month of the year, though the force is reduced materially in the fall and winter months because as a rule streets have to be wet but once a day during these periods and one team is enabled to cover two ordinary beats.

The superintendent is provided with a runabout motor car in order that he may go over the city daily to see that sprinkling is being properly carried on. Formerly the superintendent used a horse and buggy, but it was next to impossible for him to cover the territory required for the best service by that means. Since the advent in the department of the auto and two motorcycles, which are used by the assistant and the timekeeper in making the rounds for the purpose of checking up on every sprinkler and seeing that it does an honest day's work, the efficiency of the department has been greatly increased.

During a recent water scarcity, when the irrigation of lawns was ordered stopped for several days, the street sprinkling department performed great service to the community by drawing water from Cherry creek and hauling it to the dustier streets and to many suffering lawns.—*Denver Municipal Facts.*

Sewage Disposal with Respect to Offensive Odors.

By George W. Fuller, M. Am. Soc. C. E., New York City.

Odors in Sewage Disposal Works.

BRIEF mention will here be made of some of the factors which now appear to be of importance with reference to some of the leading methods or steps in the processes of disposal of sewage.

DILUTION.

Degree of Dilution.—In 1887 Mr. Rudolph Hering recommended a dilution of 3 1/3 cubic feet of water per second, per thousand population connected with the sewers, as the basis for the design for the Chicago drainage canal. That project was put in service in January, 1900, and is now providing approximately the degree of dilution indicated by the original design. Precise data are not at hand to indicate whether or not the organic matter is provided with sufficient oxygen to allow bacterial decomposition to proceed at all times during the flow of 23 miles on an aerobic basis. But in a general way it seems that the dilution above mentioned is adequate with respect to guarding against offensive smells so far as domestic sewage is concerned. Trade wastes at Chicago, particularly from the stock yards district, seems to indicate the desirability of making the dilution somewhat greater than above stated unless such wastes are treated before entering the sewers. It is understood that during warm weather some odors are noticeable at or near the bear-trap dam at the foot of the canal. At this place, at the power plant and at the falls in Joliet, Ill., it is to be borne in mind that considerable opportunity for aeration is afforded the diluted Chicago sewage. The necessary degree of dilution as studied by the engineers of the Massachusetts State Board of Health has been found under different conditions to range from 3.5 to 6 cubic feet per second as the necessary flow of water for each thousand population connected with the sewers. These observations are based upon small streams in many cases where manufacturing wastes are a factor of importance, through the use of oxygen, which they divert from that needed for the sewage.

It is also true in some cases that deposits of sludge in mill ponds and elsewhere likewise are entitled to consideration, so that, as a general rule, it may be said that the Chicago basis of dilution for domestic sewage seems to be adequate to

guard against objectionable smells so far as domestic sewage is concerned in well-oxygenated streams where deposits of sludge are not a factor.

Dispersion.—In a great many cases suitable sewage disposal by dilution is seriously handicapped through failure to disperse the sewage adequately in the flowing stream. That is to say, some portions of the stream near the margin are grossly overtaxed with sewage with resulting putrefaction, whereas toward the center the capacity of the stream to receive sewage is but partially utilized. This applies also to sewer outlets on tidal flats at many places. The only fair and reasonable way to utilize the dilution method of sewage disposal is to provide for prompt and complete dispersion of the sewage in sufficient water so that the exhaustion of oxygen will not result. Failure to do this has done much to give this method of disposal an undeserved reputation of producing objectionable odors.

Sludge Banks.—The discharge of crude sewage into various streams results, of course, in a checking or the velocity and the consequent deposition of coarse suspended matters which form sludge banks. Where range in water level, especially on tidal flats, is such that the bottom is exposed at times, these sludge banks may putrefy and give off objectionable odors. In some cases the conditions may be such that it may be advisable to allow the great bulk of the suspended solids to flow into the diluting stream and remove them by dredging with such frequency as to prevent serious putrefaction. Combining the effect of sludge banks with inadequate dispersion of sewage in the flowing stream, it is not unusual to find that in the shallow water near the shore of quite large rivers there are objectionable odors, notwithstanding that near the middle of the river the water contains a great surplus of oxygen.

Floating Solids.—This feature does not deal so much with the question of objectionable smells as it does with the unsightly appearance of the diluting body of water, due to readily visible particles of matters entering with the sewage. Where the diluting water is fairly free of turbidity it is especially important, as is done in many cases in Europe, to consider means for the removal of the coarser solids by screens or otherwise.

Grease and Scum.—What has just been said with respect to the coarser solids applies in some measure to those fatty and oily substances which have a specific gravity lighter than water, and hence a tendency to appear upon the surface of the water into which the liquid is discharged. These substances do not relate particularly to the odor question, but rather to the question of unsightly appearance of the diluting water. They can be removed to a considerable extent with the aid of baffles and scum boards.

Protection of Fish Life.—A number of streams in this country have caused considerable trouble at times as to offensive smells due to the killing of large numbers of fish, as a result of exhausting the dissolved atmospheric oxygen in the water. This question brings up one of the mooted points at present in the disposal of sewage by dilution, namely, the safe margin of residual oxygen to allow in the water receiving the sewage. As a general proposition, the available evidence indicates that ordinary major fish may be reasonably provided for when the dissolved atmospheric oxygen in the body of the diluting water does not become less than about 33 per cent. of that necessary for saturation. The result of German investigations cited in Lunge's Technical Methods of Chemical Analysis, Vol. 1, Part II, page 386, where reference is made to the poisonous effect upon fish of 8 to 12 parts per million of hydrogen sulphide.

Residual Dissolved Oxygen.—It has recently been suggested that a margin of 75 per cent. of that necessary for saturation of the diluting water should be provided in ascertaining the proper degree of dilution of sewage. It is believed that this is seriously in error as an unqualified general proposition. It may be predicated perhaps to a considerable extent upon observations made at points where sludge banks and improper dispersion of the sewage have caused offensive conditions to arise, but which could not exist if the above features were properly carried out. The extraordinary aspect of this proposition is that it would eliminate some of the largest rivers in this country from the list of those capable of properly receiving sewage by dilution, notwithstanding the fact that such rivers after proper filtration serve as the source of satisfactory domestic water supplies. On the other hand, it is quite probable that the degree of dilution established at Chicago might have to be increased materially if certain kinds of fish life were to be satisfactorily taken care of as distinguished from guarding against putrefactive odors. On the latter score there is no question about aerobic conditions prevailing with a substantial absence of offensive smells so long as there is a small but well-defined margin of dissolved oxygen present at all times and at all places. This follows from the early discussions in this paper with respect to the fundamental principles of the oxidizing and reducing fermentations of sewage, as established at Lawrence more than twenty years ago.

REMOVAL OF SUSPENDED SOLIDS.

The extent to which it is advisable to

remove suspended matter from sewage depends largely upon the manner of its final treatment. In the case of dilution where there is ample dissolved oxygen, as above mentioned, that method of disposal calls for the consideration of the removal only of the coarser solids. Some styles of filtration, however, for reasons of economy and efficiency call for clarification to a substantial extent for the reason that it is easier and cheaper, all things considered, to filter a clarified sewage than an unclarified sewage.

The proper scope of the different devices for the removal of suspended matter and the conditions under which they may operate with reasonable freedom from objectionable smell are outlined as follows:

Grit Chambers.—These arrangements comprise very small compartments, in which coarse matters may be removed by sedimentation. As the term is ordinarily applied, it refers to the deposition of road wash in connection with a system of combined sewers. If these basins are made too large they add complications on account of having too much organic matter in the deposited solids. A reasonable allowance is to provide a velocity ranging from 6 to 12 inches per second, which corresponds to a sedimentation period of only a very few minutes. Naturally the sewage after passage through such a basin contains substantially its full quantity of organic matter, and hence the putrescibility of the sewage is affected but slightly. In connection with dilution methods it is sometimes better, however, to remove this coarse matter in basins rather than to have to dredge it from slips and flats after it has been deposited in the body of the diluting water. Where works of artificial construction involving fairly complete purification are installed, it is frequently found cheaper to remove the suspended matter of a mineral nature as a preliminary step rather than to allow it to become mixed with the suspended organic matter which needs more careful treatment when guarding against odors.

Screening.—Coarse screens are of importance in protecting pumps in plants where pumping is required. In the case of disposal by dilution, screening is frequently desirable to remove unsightly solids from the sewage. The position of screens in connection with filtration plants is now in an unsettled state, particularly with regard to fine screens. It goes without saying that the solids which are capable of being removed by screens should be taken care of in a sanitary way without producing offensive smells regardless of the detail of procedure. On this basis it becomes a question of determining whether fine screens afford a cheaper and better way of treating the solid matters than do settling tanks with suitable baffles and scum-boards. The final answer to this question can scarcely be given from the present evidence. In a general way the question of economy is an important one and varies with the size and local features of the works. For large plants mechanically-operated screens have a considerable field of usefulness, whereas the cost of maintenance frequently precludes the use of screens for very small plants. The disposal of the screenings is an item of considerable expense unless they can be freed of water so that they can be put under a boiler of some convenient power plant or taken to a city incinerator. Disposal by burial affords good results during the warmer seasons of the year with good management. In northern climates burial is not feasible during the winter and accumulations of screenings sometimes give offense in the spring before the winter accumulations are finally disposed of. Incinerating plants for screenings alone require considerable fuel, but, excluding the item of expense, this is a suitable way of disposing of the screenings without local offense.

Scum Boards.—There is considerable room for improvement in arranging scum boards or baffles so as to retain suspended matters which float upon the surface of the sewage, as it passes through basins for sedimentation or other purposes. In small plants, as already intimated, it is quite likely that screens may be advantageously eliminated if at frequent intervals the surface accumulations are thoroughly removed and disposed of in a satisfactory manner.

Sedimentation.—Depending upon the strength of the sewage and the size of the sedimentation basin, it is perfectly feasible to remove from 50 to 75 per cent. of the total suspended matter in sewage and about one-half of this percentage of the total organic matter as measured by ordinary laboratory methods. Reduction of putrescibility, however, according to Hoover's tests at Columbus, is only about 80 per cent. as great as is the removal of total organic matter. As regards freedom from odors, it is necessary to prevent putrefaction in the chamber in which sedimentation occurs. Properly speaking, this applies to the surface of the liquid, and to the deposits upon the walls and particularly to those deposits which appear upon the floor of the basin and are ordinarily spoken of as "sludge." This sludge disposal question is by far the greatest single problem in connection with sewage purification, and with ordinary sedimentation basins the quantity amounts to some 5 to 7 cubic yards per million gallons of sewage treated, with 90 per cent. of water in the sludge. Where

chemicals are employed to facilitate clarification by sedimentation, the removal of suspended matter reaches from 80 to 90 per cent., and that of the total organic matter ranges from 50 to 55 per cent. The amount of sludge is about double that obtained with plain sedimentation or even more where the percentage of water is very high. With these devices freedom from odor is also predicated upon cleaning at sufficiently frequent intervals to guard against putrefaction.

DISPOSAL OF SLUDGE.

As already stated, this is the great problem of sewage disposal, and reference will be made briefly to the principal methods of disposal of sludge and particularly to the latest arrangements for the septicization in two-story tanks of the Emscher type.

Sludge Beds.—The fairly fresh sludge removed from plain sedimentation chambers is frequently applied to special sludge beds, where the thick liquid becomes a solid mass, due to the removal of water, partly by evaporation and partly by percolation through the material to which the wet sludge is applied. Generally there is removed with the sludge and scum considerable fairly clear liquid which lies between the bottom deposit and the surface scum. The organic matter is in a state where it readily putrefies and odors of putrefaction are liable to result in the old-fashioned sludge bed. After the material has lost a part of its water it is sometimes carried away by farmers to be utilized for fertilizing purposes, but this is not a procedure that can be relied upon. Taken altogether, the sludge bed is quite an unsatisfactory method on a large scale of disposing of sewage sludge from the modern standpoint. Where it is applied with moderate success its operation is usually confined to the cooler seasons of the year, when the sludge may become thoroughly dried and removed before warm weather sets in.

Sludge Lagoons.—This procedure is very similar to the sludge bed, except that dikes are employed so as to permit of storing the sludge to a much greater depth than in the ordinary sludge bed. In some places, as at Reading, Pa., this has worked out satisfactorily for several years. The sludge disappeared in volume to the extent of about 50 per cent. Objectionable odors are noticed at times within 100 to 200 feet of the lagoon, but are not noticeable to a greater distance, according to present evidence. Whether this would be true with the sludge from all plants is, of course, uncertain. Covers for lagoons have some merit as compared with open lagoons, but except for unusual conditions their utility is far less than the arrangements like the Emscher tank.

Sludge Trenches.—Sludge trenches, when covered, allow sewage to become well rotted and with the odors greatly minimized due to their passage through the material overlying the trench. For small plants this process seems to have much merit, especially in the northern climates. For large plants, however, it does not afford competition with the Emscher tanks.

Dilution.—This method is rarely applicable on account of the peculiar conditions which are required in order to justify its use. Its applicability relates to conditions where sludge may be allowed to accumulate in tanks for months at a time and then be discharged at time of flood flow into a sizable river. Its practical merit depends upon whether the storage facilities for sludge for some months at a time are a simpler and cheaper arrangement than devices for the removal and disposal of sludge at frequent intervals. A dilution of sludge of about 1 to 800 seems to provide satisfactory results according to observations at Columbus, Ohio, in the Scioto river when it is in flood.

Septicization in One-Story Tanks.—The ordinary septic tank is essentially a plain sedimentation tank operated so that the sludge on the floor of the tank, with whatever scum accumulates on the surface, is removed only at very infrequent intervals. This is a patented process covered by the Cameron patent (No. 634423), of which the following claims were adjudicated as patentable in the Saratoga Springs case:

"(1) The process of purifying sewage which consists in subjecting the sewage under exclusion of air, of light and of agitation to the action of anaerobic bacteria until the whole mass of solid organic matter contained therein becomes liquefied, and then subjecting the liquid effluent to air and light.

"(2) The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage, having a non-disturbing inflow and outflow, from light, air and agitation, until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, and then subjecting said pool under exclusion of light and air and under a non-disturbing inflow and outflow to the liquefying action of the so cultivated micro-organisms, until the solid organic matter contained in the flowing sewage is dissolved.

"(3) The process of liquefying the solid matter contained in the sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow, from light, air and agitation until a mass of micro-organisms has been developed of a character and quantity suffi-

cient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, then subjecting said pool under a non-disturbing inflow and outflow and under exclusion of light and air to the liquefying action of the so cultivated micro-organisms until the solid organic matter contained in the flowing sewage is dissolved, and then subjecting the liquid outflow to an aerated operation.

"(4) The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow from light, air and agitation until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, then subjecting said pool under a non-disturbing inflow and outflow and under exclusion of light and air to the liquefying action of the so-called micro-organisms until the solid organic matter contained in the flowing sewage is dissolved, then subjecting the liquid outflow to an aerating operation, and then to a filtering operation.

"(21) The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow from light, air and agitation until a thick scum is formed on the surface thereof and a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, and then subjecting said pool under the cover of said scum and under a non-disturbing inflow and outflow to the liquefying action of the so cultivated micro-organisms until the solid matter in the flowing sewage is dissolved."

During the Saratoga litigations it was understood by all concerned that the life of the Cameron patent would expire in November, 1909, which was the 14-year life of British patents, dating from the time of issue of the Cameron patent in Great Britain. Since that time the question has arisen, with respect to the Cameron patent and others of foreign origin, as to whether the International treaty of Brussels in 1903 should be made retroactive or not. If made retroactive the Cameron patent would have the American life of 17 years from the time of its issue in the United States, that is, it would continue until October 3, 1916. This question is not yet finally adjudicated. It is understood that the Cameron Septic Tank Company has received an unfavorable decision in the lower Federal Courts in their suit brought against Knoxville, Iowa, but that an appeal was taken to the U. S. Supreme Court.

The single story septic tank has its warm advocates and its strong opponents. Likewise it has merits and demerits. Briefly, its advantages are as follows: The first point results from the clarification due to sedimentation although there is no reason to believe that the septic effluent is any easier to purify than is the effluent of plain sedimentation tanks giving equal clarification. The mixing accomplished in the tanks is of some aid in making the work more uniform for filters and other following treatments. As to sludge, there is some liquefaction and gasification of suspended organic matter. The advantage of this consists in the reduced volume, permitting a much longer period between cleanings than is possible with plain sedimentation tanks. Removal of sludge under some circumstances may occur only once in four or five years or so, where the sewage is only of domestic origin, although it may be necessary to clean the tanks once a year or oftener. Septic sludge under some circumstances is considered easier to handle than is the sludge from plain sedimentation tanks, and this is probably true if the decomposable organic matter is well rotted out or humified.

The disadvantages of a single story septic tank consist principally in the fact that the detention of the sewage in the tanks is under such circumstances that the dissolved oxygen in the effluent is exhausted and that putrefaction has commenced. This means that fresh sewage is not to be found in the septic effluent under ordinary circumstances, and consequently there is a greater likelihood of putrefactive odors. The products of putrefaction of the sludge arise through the flowing liquid and even in closed tanks some objectionable odors become diffused in the neighboring air. Similarly, the products of putrefaction cause some bacterial products, commonly known as toxins, to enter the flowing liquid and under some circumstances to interfere with the subsequent putrefaction. Gas ebullition with fresh sewages frequently lifts suspended matter so as to form a heavy scum, the organic matter of which is not septicised. This gas ebullition also lifts sediment from the bottom and in this way sometimes produces very serious filter clogging unless such sludge in the septic effluent is removed by devices which at best are expensive. The stirring up of the sediment layer sometimes causes a septic tank to be put out of service and perhaps cleaned when it is very inconvenient to attend to such cleaning. If it is not cleaned the septicization or the complete rotting out of the unstable portions of the suspended organic matter does not proceed reliably so as to make an inodorous sludge. The reasons why septicization in a tank that is standing idle does not pro-

ceed seems to be partly due to the absence of incoming food for bacterial growth and partly to the dying off of certain desirable kinds of bacteria due to the products of bacterial growth. The result of this is that some unstable organic matter remains in the sludge which is not humified or reduced to an inodorous product that may be satisfactorily discharged on open beds. Practice shows that stable organic matter and mineral matter in suspension are not liquefied. When this style of tank is working to best advantage as regards the complete rotting of the sediment layer there still is to be contended with at times of cleaning the disposition of the liquid contents of the tank, that is, the sewage between the sediment at the bottom and the scum at the top, as well as the fact that the scum is ordinarily not well septicized. These factors add much to the odor under some circumstances. Covers for single story septic tanks tend to minimize the odors noticeable at a distance from the plant apparently through mixing of gases and the prevention of wind and rain from promoting the transmission of odoriferous substances of a gaseous or volatile nature.

Septicization in Two Story Tanks.—These tanks have recently been referred to as the Imhoff or Emscher tanks. They have their origin from a scientific standpoint in certain tests made a dozen years ago by Mr. Clark at the Lawrence Experiment Station in the septicization of sludge in compartments separate from the sedimentation tank itself. These studies resulted as a first practical outcome in the so-called Travis Hydrolitic tank at Hampton, England. These tanks have horizontal partitions or baffles which separate the upper sedimentation chamber from the lower digestion chamber in which septicization takes place. The partitions have a steep slope which allows the deposit or sediment to slide through a slot at the bottom into the digestion chamber substantially as fast as it appears in the sedimentation chamber below. The lower edge of one of these partitions extends beyond the edge of the other partition. In this way the gas resulting from the septicization in the lower compartment cannot pass through vents at the side. The principal difference between the Travis tank and the Imhoff or Emscher tanks is that in the former a certain portion, say 20 per cent., or so, of the sewage passes regularly through the digestion chamber. In the Imhoff tank, however, none of the contents of the digestion chamber are allowed to mingle with the effluent of the sedimentation chamber above.

These two story tanks seem to possess all the advantages of a single story tank and especially are they superior in that they allow a settled effluent to be obtained which is substantially as fresh as the unsettled sewage reaching the plant. In other words, a settled sewage is obtained which is at all times free from the results of septicization as to putrefactive products and the sludge of the digestion chamber. The sludge is freed from the sedimentation basin automatically and continuously and it is not necessary in removing the digested sludge to deal with a sedimentation chamber full of fresh sewage, perhaps with more or less scum upon it. In brief, it is possible to obtain a sludge which in a suitably designed tank has remained in the digestion chamber for a sufficient number of months to become so thoroughly rotted out that it is well humified and quite inodorous. Furthermore, a sludge can be obtained under ordinary circumstances from these deep tanks such that its removal and its separation from water is much easier than with ordinary septic tank sludge. The deep tanks under the conditions as tested for some three years or so in the Emscher district of Western Germany seem to be unusually free from odor as compared with the single story tanks or even two story tanks in which some sewage constantly passes through the digestion chamber. This seems to be due to a number of factors, among which may be mentioned the greater coefficient for the absorption of gases by liquids under a greater depth and pressure, and also the mixing which seems to take place. This mixing seems to promote the absence of large bubbles rising vertically so as to make their escape into the atmosphere of the surface. Perhaps, the latter is also due in part to the additional opportunity afforded for combination of gases with the liquid in the chamber.

The disadvantage of septicization in two story tanks is that the tanks are more expensive and difficult to build than one story tanks, particularly if the lower portions are to be built in rock, ground water or quicksand. The scum of floating matters on the surface of the liquid in the sedimentation chamber require frequent and careful attention to guard against odor. Under some circumstances this may be true of the scum which appears on the surface of the gas vents connecting with the digestion chamber. The sludge cannot be removed and dried on thin gravel beds in an advantageous way during the severe winter weather in the northern climate, and hence it is necessary to build the digestion chambers under some conditions that are very large. The process does not prevent sulphuretted hydrogen formation in the sludge, but with good management it seems to minimize the escape from the digestion chamber of objectionable gases into the surrounding atmosphere.

Causes and Effects of Public Utility Commissions.*

By J. H. Roemer, Madison, Wis.

WITHIN the last few years a somewhat general demand for the enactment of laws creating public service commissions, with power to regulate all public service corporations, has arisen in many states. This seems to be the natural and logical sequence of the regulatory measures respecting railroads and other common carriers now in effect in the nation and in most states. Whatever may be the views and attitude of those who manage and direct the affairs of such corporations in respect to the subject, the time has arrived when state surveillance of all corporations and individuals engaged in public callings is essential to the common weal. Unfortunately, however, the real reasons justifying such action on the part of the state have not always been advanced or been potent to create public sentiment favorable to such legislation. Much of the agitation has been, and is, based upon superficial and inconsequential grounds, and emanates from a somewhat general conviction that most public service corporations are exacting exorbitant charges from the public for the services rendered, and are concealing the fact by paying moderate dividends upon a fictitious capitalization. While the view thus entertained is grossly exaggerated, it cannot be successfully controverted that over-capitalization, coupled with imprudent management, has frequently been a menace to the proper performance of the public functions of such corporations according to the full measure of duty imposed upon them by laws as well as by voluntary contractural provisions. In such instances the eagerness of managements to demonstrate their administrative ability, by declaring dividends upon stock, results in the curtailment of operating expenses to such a degree that the rendering of efficient service becomes impossible, also in the neglect of proper maintenance of the property and in the failure to make provision for depreciation. Thus the public, on the one hand, is made to suffer by reason of poor service, and the bondholders, on the other hand, are likely to suffer by reason of the diminution in value of their security. Under such circumstances, when replacements become necessary to the continuance of operation, they can be provided only by the issuance and disposal of additional securities. Thereby the capital account becomes charged with expenditures that should have been taken and saved from the operating revenues.

Much hostility also to the managements of public service corporations has been engendered by negotiations between municipalities and such corporations for the granting of franchises, which negotiations have not always been free from the suspicion that improper methods have been employed to induce those representing the public in the transactions to consent to terms and conditions detrimental to the public interest. As a result public service corporations are more or less a factor in local politics, and the manner of their regulation is often an issue in local political campaigns. This is unfortunate, both for the public and the corporation, for the legitimate interests of both in the public utility are jeopardized. In the conflict neither seems to recognize its proper relation to the other, nor to realize that the effective regulation of a public service corporation, in respect to the performance of its public function, cannot be had by means of ordinances or contracts. As franchises are usually for a long term of years, it is obvious that the attempt to prescribe in detail the obligations of the public utility to the public, or *vice versa*, during the life of the franchise, must of necessity fail. No one can foresee in a quarter century the changes in the arts embraced in public utility service, the development and necessities of the communities served or the requirements of the utilities to perform their functions under conditions which must necessarily change in the progress of time. Less than two decades ago I saw in my home city an electric power plant just completed which was regarded the most modern and efficien plant of the kind in existence. Its capacity was considered enormous. Engineers and others interested in the advancement of the art of generating electric energy came from all sections of the country to view this plant, which was equipped with the most modern appliances.

For the past few years this plant stood idle most of the time, serving merely as an auxiliary in emergencies. It is but an evidence of how rapidly the art has advanced and rendered obsolete the most

*From a paper before the Illinois Gas Association.

expensive appliances. The advancement in the art of telephony within a very few years is little less than marvelous. Costly equipments have been scrapped and the entire systems reconstructed to meet the public requirement for the best service. In other utilities the changes have not been so marked, and equipment has become more or less standardized; but who can tell what a quarter of a century may bring forth in any art or science? To meet the conditions as they arise is the only way that the best interests of the public and utilities can be conserved in the matter of rates and service. Any franchise which attempts to anticipate the needs of the future in these respects, and provide for the same, which most franchises do, sooner or later becomes inadequate to satisfy existing requirements and prolific of contention between the community and the utility. Even where the right to fix rates and establish standards of service from time to time has been reserved to common councils in such franchises, intelligent action has been rare. The expenditure of large sums of money by the larger municipalities, to ascertain all of the essential facts necessary for intelligent and lawful action on the part of the common councils invested with power to establish rates, has more frequently been wasted than profitable, as the facts thus acquired have generally been ignored and action taken which was either prompted by prejudice or based upon ulterior political considerations. Litigation necessarily followed, which involved the further outlay of large sums of money on the part of the public and the utility, all of which in the end had to be paid by the taxpayers and patrons of the utility.

It was with a view of placing public utilities upon a sound basis and eliminating all unnecessary friction between the public and such concerns, due to causes arising from ignorance of the economic status of public utilities and their moral and legal relations to the public, that the Wisconsin Public Utilities Law was framed and enacted. The economic features of this law, which are fundamental in its structure, are the result of exhaustive study and investigation and consideration given to the subject by Prof. John R. Commons, University of Wisconsin. After more than three and a half years' administration of the law the wisdom of the sound, economic basis upon which the law was constructed has been demonstrated, and the results obtained from its operation have been generally satisfactory to the public, the utilities and the investors in the securities of such concerns.

Among the more important provisions of the law are those relating to valuation, uniform accounting, standard units of products or service, publicity of rate schedules, fixing of rates and regulations, indeterminate franchises and the purchase of public utility plants by municipalities. It will be impossible to consider at length the effects of all these various provisions without extending this discussion to an inappropriate length. However, reference will be made to the more important features of the law that its general effects may be more fully appreciated.

The law requires the Commission to value "all the physical" property and "all the property actually used and useful for the convenience of the public" of every public utility subject to its provisions. Over 1,000 public utilities in the State are under the regulation of the Commission. Of these the Commission has appraised to date about 100. The method of valuation adopted by the Commission, as shown by its decisions, is a subject of such magnitude that it cannot be touched upon here. Suffice it to say that no appeal has even been taken by either a utility or a municipality from any valuation made by the Commission, and that the question of capitalization is no longer capable of seriously inflaming the public mind in any community in Wisconsin.

Very soon after the enactment of the law preliminary steps were taken by the Commission toward carrying into execution those provisions relating to the establishment of standards for the quality of service rendered by the public utilities companies, and to the enforcement of such standards in a manner consistent with the spirit of the law. It was realized from the first that the proper administration of the provisions of the law relating to standards of service would necessitate the establishment of a circulating laboratory equipment, to be used in fixing the legal units and standards, and in putting the same into practice on a permanent and uniform basis throughout the State. After some preliminary discussions and conferences an agreement was entered into whereby the extensive laboratory facilities of the University of Wisconsin were, as far as practicable, made available for the purpose of the Railroad Commission, with the understanding that there should be reciprocal use of the instrumental equipment to be purchased subsequently by the Commission. This arrangement proved especially advantageous to the Commission, since it afforded an opportunity to act with deliberation in choosing the instrumental equipment ultimately required in handling the work on a large scale. Following closely upon the agreement with the University authorities above mentioned, the co-operation of the United States Bureau of Stand-

ards at Washington was solicited with the further result that definite arrangements were made whereby the standards used in the administration of the Wisconsin public utilities law shall, as far as practicable, be subject to verification and control with reference to the official government standards at Washington.

A further instance of important co-operative work during the preliminary period of developing standards, and in the selection of testing equipment best suited to the demands of the situation in Wisconsin, consisted in the appointment by the American Gas Institute of a special committee on gas calorimeters. One of the members of this committee was Prof. C. F. Burgess, who is in charge of the gas and electric service inspections for the Commission. Part of the work of that committee was handled by members of the Commission's staff, and the results of these investigations were made immediately available for use by Wisconsin's gas plants.

Gas and Electric Service Inspections.—The arrangements above outlined, it should be explained, while intended to apply to any phase of the question of units or standards which might arise under the public utilities law, were naturally of more immediate use to the Commission in connection with gas and electric service.

A preliminary canvass of current practice, relating to standards of gas and electric service elsewhere in the country, threw but little light upon the question of fixing the proposed standards. In fact, it was at once realized that a special field study of the services actually rendered by the Wisconsin gas and electric companies would be a necessary preliminary to the intelligent formulation of the contemplated standards of service and the rules governing the same. In undertaking these field studies it became necessary to provide special field equipment which early took definite form as "traveling laboratories." After some progress had been made in this preliminary investigation, the results were thrown into shape, to be presented at a general conference at Madison in March, 1908. At this informal hearing the owners and operating officials and experts of the various gas and electric companies of the State were given an opportunity to express their views in relation to the proposed standards of service. The programme or outline of these discussions included the following points:

GAS SERVICE.

I. Accuracy of meters:
   1. Method of testing.
   2. Limit of error allowable.

II. Calorific valve:
   1. Importance.
   2. Method of testing.
   3. Minimum value.
   4. Variation allowable.
   5. "Gross" or "net" values.

III. Candle power:
   1. Importance.
   2. How defined.
   3. How measured.
      a. Kind of photometer.
      b. What standard.
      c. What kind of burner.
   4. Minimum value.
   5. Variation allowable.

IV. Composition:
   1. Restriction as to impurities.
      a. Ammonia.
      b. Sulphur—total.
      c. Sulphur as HS.
      d. Diluents.

V. Installation:
   1. Safety.
   2. Adequacy.

VI. Pressure.

ELECTRIC SERVICE.

I. Accuracy of meters:
   1. Method of testing.
   2. Limit of error allowable.

II. Uniformity of voltage:
   1. Allowable variation from normal.
   2. Interruptions.

III. Lamp efficiency:
   1. What provisions for lamp renewals.
   2. Voltage.

IV. Installation:
   1. Safety.
   2. Voltage Limits.
   3. Adequacy of wiring.

In addition to those directly representing Wisconsin interests, there were present at this conference gas and electrical experts from other States, also an official representative of the Government Bureau of Standards. The proceedings of this conference were supplemented, upon request by the Commission, by communications received from those in attendance and from other sources. In the light of the information thus gathered, and further important data brought together through the means of additional tests of service throughout the State, a preliminary set of rules relating to gas and electric service was formulated by the technical staff serving the Commission. After further conference and discussion, these rules were officially adopted by the Commission, July 24, 1908, to become effective three months thereafter (see decision No. U-21, "*In re* standards for gas and electric service in the State of Wisconsin").

EDITORIAL · COMMENT

Cost Accounting and Contracting Practice.
Water Waste. Chicago Paving Investigation.

COST ACCOUNTING AND CONTRACTING PRACTICE.

The series of practical papers on "Contracting Practice" which is at present appearing in these pages has given rise to some discussion among contractors who are seeking to better their methods. Much has been written regarding more efficient methods of handling details in contract work, and volumes have been published giving figures of cost gathered from specific jobs and tabulated, and published to be later applied on other and perhaps dissimilar work. The general dissatisfaction caused by the following of the so-called cost data set forth in this class of matter leads the average contractor to feel that his problems are unique and that the methods and costs offered are inapplicable to them.

The contractor has learned, through experiences, that the large volumes of cost data which are presented to him periodically are not directly applicable to any particular job, except the one upon which they were originally used. He has recognized also that the discussions on "Efficiency" or "Efficiency Engineering" are hopelessly beyond his grasp and he hasn't the time to pick out the basic thoughts and apply them to his own work.

In the series of articles by Mr. Moore no attempt has been or will be made to offer any iron-clad "rules of conduct" or to tell the contractor the costs of materials or labor in specific instances. It is the purpose of these articles to present the common-sense methods which have been used and found valuable in actual practice. The tabulated forms and data sheets shown are not of such a complicated nature as to require the contractor using them to have a store room filled with blank forms; but they are of such a nature that the average contractor may in a few minutes rule up a sheet to answer the purposes advocated, the same as obtained in the larger offices by the use of carefully printed form sheets.

Some sewer or pavement contractor may glance hurriedly at one of the plates shown and note perhaps that the items noted are for building construction. This may lead him to think that the forms are useless for his purpose and inapplicable to his work. Such, however, is not the case, as will be noted on more careful consideration. The divisions and column headings used are general in their application and may be used with equal value upon any kind of general contracting work. Building construction is used for illustration simply because of the uniformity of items.

Mr. Moore has kindly offered to suggest, in response to inquiries, either personally or through MUNICIPAL ENGINEERING, answers to any specific questions regarding the adoption of his methods or the use of his tabular forms in particular instances. His experience covers a wide range of contract work, including practically all branches of municipal work, building construction, railroad construction, industrial and public building construction, bridge work and hydro-electric development.

A careful study of methods in work, including over one hundred and fifty contracts, enables Mr. Moore to appreciate the problems of the average contractor and to offer practical, common-sense methods for handling their work.

WATER WASTE.

Special attention is called to the article in this number of MUNICIPAL ENGINEERING on the Memphis investigation of the waste of water, because it contains many points of interest which may not

appear on casual reading. For this reason the article is printed in full as it appears in the annual report of the Water Commissioners of Memphis, the work having been done and the report prepared under the direction of Carl E. Davis, the efficient resident engineer of the plant. One or two points may be mentioned to show what can be found in the data given if one will hunt for what he wants.

The difference in the consumption of water by white and colored people is quite marked. The following table shows this as to metered water:

	Consumption (Gals.) by		
District.	Total	White	Colored
1	28.0	33.2	17.6
2	19.1	21.0	14.2
4	14.8	16.0	11.7
5	23.0	48.0	18.0
6	22.0	25.0	18.0

The character of population other than color does not have so marked an effect upon the consumption, as shown by the above supplemented by the following: District No. 1 has a first-class residential district along its north and east sides, a small manufacturing district and a large remainder of thrifty property owners with good plumbing. About one-third the population is colored. The second district is almost entirely middle-class residences. Population is about 28 per cent. colored. The fourth district has sawmills and lumber yards and good suburban residences. About 20 per cent. of the population is colored. The fifth district is largely a colored tenement district, nearly 87 per cent. colored population, and there are but 174 white persons using metered water. The sixth district is perhaps half a poor class of rental property and half good residences, not quite 28 per cent. colored population.

The consumption of water in each district, of metered water and unmetered water, and the per capita consumption where possible to compute it are shown in the table in the article referred to. The unmetered consumption includes not only the water used by consumers on flat rate, but also the leakage, water used for public purposes, water not paid for, etc. The differences between the consumption per capita of consumers using metered water and of the total population of the districts are enormous, but the figures are not comparable for the reasons noted. The paper shows the results of the reduction of leakage, but it does not make any estimates of the water used by business and manufacturing purposes not metered, for public purposes, or donated, so that the actual private consumption of water can not be approximated from the figures in the report. Undoubtedly there is much waste in all these directions and it is very probable that an investigation of the unmetered water would result in more saving than that of the metered water and the leakage in mains and services is effecting. This latter saving ranges from 5 to 43 per cent. in the various districts, averaging 16 per cent. for the part of the city covered by this investigation.

Those considering the question of waste will find the points suggested and others worthy of careful study for the light the information given may throw on their own problems.

CHICAGO PAVING INVESTIGATION.

The Chicago Bureau of Public Efficiency has been conducting for several months an investigation into the specifications for and methods of construction of pavements in that city under the efficient supervision of its chief engineer, A. J. Hammond, M. Am. Soc. C. E., and advice of Samuel Whinery, M. Am. Soc. C. E. The results of this investigation have just been published in a 40-page booklet which can probably be obtained of the Bureau on application to its office, 900 Masonic Temple.

The report proper is divided into eleven subdivisions.

It first pays its respects to the conventions of the Association for Standardizing Paving Specifications, particularly to the star-chamber methods of the New York convention. The lines were drawn fully as closely as the report describes, Mr. Hammond, the representative of the Bureau, and the writer, an accredited representative of the committee on standard specifications of a sister organization, as well as others, being refused opportunity

to listen to the deliberations of committees and appearance in any manner before that on wooden blocks, of which Mr. Tillson of New York was chairman.

Some modifications in the Chicago specifications are recommended, but the adverse criticisms in the report are principally with respect to the character of the workmanship and the inspection of subgrade, curbing, combined concrete curb and gutter, concrete, asphalt pavement, granite block pavement, creosoted wood block pavement and brick pavements. The reason for the defects observed in the work is discussed under the heading of inspection, and the great value of statistical data on traffic, wear of the various pavements, laboratory tests of materials, etc., is clearly shown, as well as the absolute dearth of such material in the reports and records of the city departments.

The principal subject of discussion in the report is creosoted wood block pavement and many defects in the standard specifications adopted by the city of Chicago from the Association for Standardizing Paving Specifications are considered in detail. These include the specification for kind and quality of timber, although the quality of the blocks actually laid in Chicago during the period of the investigation was found to be satisfactory. There is a full discussion of the relative value of creosote and tar oils as wood preservatives, the value of creosote being clearly shown, while the value of the tar oils is as yet not demonstrated. The increase in specific gravity of the material for treating wood blocks up to the latest specification, which almost entirely cuts out creosote as an ingredient, is sketched and definite and unequivocal statements of the practical impossibility of fulfilling the specification except by the use of coke-oven tar are made. The method of cutting out water-gas tar is also shown. The permanence of the effect of coal tar creosote is shown by the results of government tests which show that creosote of proper quality is not subject to excessive evaporation. The desirability of having a material for treating blocks which is water-proof is also considered, and the possibility of using water-gas tar for this purpose is shown in case the specifications did not require a pure coal tar product. The trouble from "bleeding" with blocks treated by the new process is described and some explanations of the phenomenon are offered, that preferred being that "under the influence of heat and its expansive effect on the blocks, augmented possibly by the evaporation of the moisture imprisoned during the steaming process hereinbefore referred to, the tar is forced out of the pores of the wood and forms a coating, whereas, if creosote oil alone is used, the slight exudation is not sticky and objectionable, as is the tar." The experiences in Chicago under the new specifications and in Indianapolis, which has returned to a creosote oil specification after some years use of a mixture of creosote and heavier tar oils, are cited in support of this statement. The writer corrolorates the statement regarding Indianapolis, from observation of a street under construction, which has "bled" to some extent under the recent hot weather, but is not sticky and is kept in reasonably satisfactory condition during the construction period by the use of sand and dust.

The report brings together all the criticisms which have been made of the actions of the Association for Standardizing Paving Specifications, makes them definite by means of names, dates and places, and applies them to the Chicago conditions in a manner which is clear and convincing and which, if based on incorrect information, must be answered by the supply of correct data. It can not be answered by the indefinite statements made by the committee of the Association referred to as to the possibility of independent supplies of material, nor can the specifications stand the attack upon their sufficiency and correctness without more defense than the simple reiteration of their provisions, which is the only reason for their existence which has yet been offered.

MUNICIPAL ENGINEERING has published within the last year most of the information given in the report, but commends to its readers the concise, clear and logical statements and arguments contained in it, which will be of great value to every one interested in paving, particularly in wooden block and asphalt paving.

THE QUESTION DEPARTMENT

RMP

Books on Concrete Construction.

Please send us a list of publications on concrete construction.

B. B., Eldorado, Iowa.

The best descriptive list of books on concrete construction is one published some years since by the book department of *Engineering News*, New York. It contains an article on literature concerning concrete and classifies the books under reinforced concrete, cement and concrete, special applications of cement and concrete, concrete blocks and artificial stone, general books in the field, other books containing more or less on concrete, foreign books except English, and trade publications.

Following is a fairly complete list of the books now in the market, including those in the above named list and others, arranged alphabetically by author's name in case name is available.

Andrew's "Practical Reinforced Concrete Standards for the Designing of Reinforced Concrete Buildings." 46 pp., $2.

Associated Portland Cement Manufacturers' (of England) "Every Day Uses of Cement." 148 pp.

Association of American Portland Cement Manufacturers' "Competitive Designs for Concrete Houses of Moderate Cost." $1.

Association of American Portland Cement Manufacturers' "Directory of Portland Cement Manufacturers of the United States." 100 pp., $1.

Atlas Portland Cement Company's "Concrete Country Residences." 94 pp., $1.

Baker's "Cement Worker's Handbook." 86 pp., 50 cents.

Baker's "Treatise on Masonry Construction. 568 pp., $5.

Balet's "Analysis of Elastic Arches." 315 pp., $3.50.

Beery's "Portland Cement Sidewalk Construction." 27 pp., 50 cents.

Bellinger and Lewerenz's "Expansion and Contraction in Concrete Structures." 32 pp., 25 cents.

Black's "Artificial Stone, Terra Cotta, etc." 92 pp., 25 cents.

Black's "Concrete." 94 pp., 25 cents.

Block, Concrete." 30 pp., 35 cents.

Blocks, Concrete. 32 pp., 25 cents.

Boynton and Mitchell's "How to Use Concrete," superficial and inaccurate. 232 pp., $1.

"Brayton Standards for the Uniform Design of Reinforced Concrete." 110 pp., $3.

Brown's "Directory of American Cement Industries. 682 pp., $5.

Brown's "Handbook for Cement Users." 378 pp., $3.

Buel and Hill's "Reinforced Concrete." 499 pp., $5.

Burnell's "Limes, Cements, Mortars, Concretes, Etc." 136 pp., 60 cents.

Butler's "Portland Cement, Its Manufacture, Testing and Use." 406 pp., $5.

Byrne's "Inspection of the Materials and Workmanship Employed in Construction." 550 pp., $3.

Cain's "Theory of Steel Concrete Arches and of Vaulted Structures." 215 pp., 50 cents.

Calcare's "Cement Users' and Buyers' Guide." 75 cents.

Cement Industry, The, descriptions of plants. 253 pp., $3.

Le Chatelier's "Experimental Research on the Constitution of Hydraulic Mortars." 128 pp., $2.

Clarke's "Architects' Handbook on Cements," a trade publication. 96 pp., $1.

Cluss's "Mortars and Concretes of Antiquity and Modern Times." 25 cents.

Considere's "Reinforced Concrete," translated by L. S. Moisseiff. 242 pp., $2.

Cummings's "American Cements." 299 pp., $3.

Davis's "Portland Cement." 138 pp., $2.

Dibdin's "Lime, Mortar and Cement, Their Composition and Analysis." 227 pp., $2.

Dobson's "Foundation and Concrete Works." 120 pp., 60 cents.

Dodge's "Diagrams for Designing Reinforced Concrete Structures, Including Diagrams for Reactions and Strengths of Steel Beams." 104 large pp., $4.

Douglas's "Practical Hints For Concrete Constructors." 60 pp., 25 cents.

Dunn. See Marsh.

Eckel's "Cements, Limes and Plasters." 712 pp., $6.

Eckel's "The Portland Cement Industry From a Financial Standpoint." 93 pp., $2.

Eno's "The Uses of Hydraulic Cement." 260 pp. Ohio Geological Survey.

Faija's "Portland Cement for Users." 110 pp., $1.20.

Falk's "Cements, Mortars and Concretes." 176 pp., $2.50.

Gatehouse's "Handbook For Cement Works Chemists." 141 pp., $1.75.

Gibson. See Webb.

Gilbreth's "Concrete System." 184 pp., $5.

Gillette and Hill's "Concrete Construction Methods and Costs." 690 pp., $5.

Gillette's "Handbook of Cost Data for Contractors and Engineers." 1841 pp., $5.

Gillmore's "Practical Treatise on Limes, Hydraulic Cements and Mortars." 334 pp., $4.

Godfrey's "Concrete," reprint of articles more or less controversial. 448 pp., $2.50.

Grant's "Strength of Cement." $4.25.

Grimsley's "Clays, Limestones, and Cements. $2.25.

Hagloch's "Art Stone," superficial. 126 pp., $1.50.

Hanson's "Cement Pipe and Tile." 110 pp., $1.

Hawkesworth's "Graphical Handbook for Reinforced Concrete Design." 70 pp., $2.50.

Heath's "Manual of Lime and Cement" in construction. 215 pp., $2.50.

Heidenreich's "Engineers' Pocket Book of Reinforced Concrete." 364 pp., $3.

Heidenreich's "Monier Constructions." 40 pp., 50 cents.

Hill. See Buel; also Gillette.

Hodgson's "Concretes, Cements, Mortars, Plasters and Stuccos, How to Make and How to Use Them." 520 pp., $1.50.

Hodgson's "Plaster and Plastering, Mortars and Cements." $1.

Houghton's "Concrete From Sand Molds." 145 pp., $2.
Houghton's "Ornamental Concrete Without Molds." 128 pp., $2.
Houghton's series of 12 handbooks for concrete users, each describing a separate special use, such as wall forms, floors and sidewalks, silos, chimneys and roof tiles, etc. 50 cents each.
Howe's "Symmetrical Masonry Arches." 170 pp., $2.50.
Howe's "Treatise on Arches." 369 pp., $4.
Jackman's "Crushed Stone and Its Uses, Facts of Importance in Connection with Modern Concrete Construction." 119 pp., $1.
Jameson's "Portland Cement," out of print. 192 pp., $1.50.
Kahn System Standards. $1.50.
Lathbury and Spackman's "American Engineering Practice in the Construction of Rotary Portland Cement Plants," a trade publication. 215 pp., $2.
Lesley's "Concrete Factories." 152 pp., $1.
Lewerenz. See Bellinger.
Lewis's "Waterproofing, An Engineering Problem." 53 pp., 50 cents.
Marsh and Dunn's "Manual of Reinforced Concrete and Concrete Block Construction." 290 pp., $2.50.
Marsh and Dunn's "Reinforced Concrete." English. 660 pp., $7.
Marsh's "Concise Treatise on Reinforced Concrete." 233 pp., $2.50.
Maurer. See Turneaure.
McCullough's "Reinforced Concrete," a manual of practice. 128 pp., $1.50.
Meade's "Portland Cement, Its Composition, Raw Materials, Manufacture, Testing and Analysis." 385 pp., $3.50.
Mensch's "Architects' and Engineers' Handbook of Reinforced Concrete Construction," a trade publication. 217 pp., $2.50.
Mensch's "Reinforced Concrete Pocket Book." 224 pp., $10.
Michaelis's "Hardening Process of Hydraulic Cements." 29 pp., 50 cents.
Moersch's "Concrete Steel Construction," Der Eisenbetonbau translated by E. P. Goodrich.
Mueller's "Manufacture of Portland Cement in the United States." 54 pp., $2.
Newberry's "The Constitution of Hydraulic Cements." 24 pp., 50 cents.
Newberry's "Hollow Cement Block Building Construction." 25 pp., 50 cents.
Newberry's "How to Use Portland Cement," from the German of L. Golinelli. 29 pp., 50 cents.
Newman's "Notes on Concrete." $2.50.
Palliser's "Modern Cement Sidewalk Construction." 90 pp., 50 cents.
Palliser's "Practical Concrete Block Making." 90 pp., 50 cents.
Patton's "Practical Treatise on Foundations." $5.
Potter's "Concrete, its Uses in Building From Foundations to Finish," English small building practice. 328 pp., $3.
Radford's "Cement Houses and How to Build Them," superficial. 157 pp., 50 cents.
Redgrave and Spackman's "Calcareous Cements." 310 pp., $4.50.
Reid's "Concrete and Reinforced Concrete Construction." 884 pp., $5.
Reuterdahl's "Theory and Practice of Reinforced Concrete Arches." 126 pp., $2.
Rice's "Concrete Block Manufacture, Processes and Machines." 152 pp., $2.
Rice, Torrance, et al. "The Manufacture of Concrete Blocks and Their Use in Building Construction." 122 pp., $1.50.
Richey's "Building Foreman's Pocketbook and Ready Reference." 1118 pp., $5.
Richey's "The Building Mechanics' Ready Reference, Cement Workers' and Plasterers' Edition." 458 pp., $1.50.
Richey's "Handbook for Superintendents of Construction, Architects, Builders and Building Inspectors." 742 pp., $4.
Riegler's "Failures in Concrete Sidewalks and How to Correct Them, with Specifications." 17 pp., 25 cents.
Ring's "Reinforced Concrete in Theory and Practice." 200 pp., $2.50.
Sabin's "Cement and Concrete." 572 pp., $5.
Sidewalks, Cement. 37 pp., 25 cents.
Spackmann. See Redgrave; also Lathbury.
Spalding's "Hydraulic Cement." 300 pp., $2.
Specifications for Cement, Standard Methods of Testing and, of the American Society for Testing Materials. Edgar Marburg, secretary. 32 pp.
Sutcliffe's "Concrete, It's Nature and Uses." 396 pp., $3.50.
Sutcliffe's "Notes on the Testing and Use of Hydraulic Cement." 376 pp., $1.
Taylor and Thompson's "Treatise on Concrete, Plain and Reinforced." 585 pp., $5.
Taylor's "Practical Cement Testing." 320 pp., $3.
Testing. See Specifications.
Thompson's "Reinforced Concrete in Factory Construction. 249 pp., 50 cents.
Thompson. See Taylor.
Tile, Cement. 50 pp., 25 cents.
Torrance. See Rice.
Trautwine's "Concrete, Plain and Reinforced." 200 pp., $2.
Turneaure and Maurer's "Principles of Reinforced Concrete Construction." 317 pp., $3.
Twelvetrees's "Concrete Steel," English. 230 pp., $1.90.
Twelvetrees's "Concrete Steel Buildings." 408 pp., $3.25.
Tyrrell's "Concrete Bridges and Structures." 128 pp., $2.50.
Warren's Handbook on Reinforced Concrete." 268 pp., $2.50.
Waterbury's "Cement Laboratory Manual." 122 pp., $1.
Watson's "General Specifications for Concrete Bridges." 82 pp., $1.
Watson's "General Specifications for Concrete Work as Applied to Building Construction." 46 pp., 50 cents.
Watson's "Standard Plans for Highway Bridges of Reinforced Concrete."
Webb and Gibson's "Reinforced Concrete," brief and general. 150 pp., $1.
Webb's "Masonry and Reinforced Concrete." $3.
Wilkes's "How to Manufacture Concrete Hollow Blocks." 16 pp., 50 cents.
Wittekind's "Hollow Concrete Block Houses." 65 plates, $1.

Books on Accounting for Contractors.

Have you book on accounting for contractor of public works, or can you refer me to any one who has?

T. A. Y.,
Manitowoc, Wis.

Garrison's "Accounting Every Business Man Should Know," ($1.32) is a good book on the general subject. The other books in print are mainly devoted to the methods of cost keeping, such as Gillette and Dana's "Cost Keeping and Management Engineering" ($3.50); Hall's "Manufacturing Cost" ($3); Arnold's "Complete Cost Keeper" ($5) for factories, etc. Special attention is called to the series of articles by DeWitt V. Moore upon "Contracting Practice," which began in the May number of MUNICIPAL ENGINEERING. They are giving some of the information which is probably desired and discuss the principles upon which methods of accounting for public works contractors in particular must be based. This is the most valuable contribution to this discussion which has yet appeared.

Manipulation in Analyzing Bituminous Paving Mixtures.

In determining the percentage of bitumen in any surface mixture, a large percentage of dust remained in the pores of the filter paper. Would you kindly explain through your query column the standard method for determining this? I have read Richardson on the subject, but his explanation does not appear to be sufficiently specific.

B. J. H., Stockton, Cal.

The chemists versed in bituminous materials who have read this question state that the simplest process in the filtration method is to use filter paper leaving no ash and burn it after drying, the residue being the mineral matter referred to. Mr. Richardson removes that which can be brushed off easily so as to leave as little as possible in the filter paper.

Will our readers state the details of their methods of manipulation for the benefit of our correspondent as well as others?

Inspectors' Notes on Sewer Work.

Less than a year ago I saw I believe in your magazine a system for an inspector's notes on sewer work. I have looked but cannot find it. Can you advise me in what number it was?

S. W. H., South Norwalk, Conn.

Probably the article in vol. xxxix, p. 471, is the one asked for. This article does not give a system for keeping inspector's reports but it gives references to a number of earlier articles on the subject, of which there are several in vol. xxxviii and earlier volumes. A form of record of city improvements in vol. xl, p. 222, may aid in the study.

How to Prevent Silting Up of Drainage Ditches.

I am interested in methods used to prevent the silting up of open drainage ditches with broken gradient, which resolves itself into the problem of maintaining a uniform velocity throughout the ditch. These breaks of grade most frequently occur at the outlet of lateral ditches into the main drain, lateral ditches sometimes entering a main drain several feet above the bottom of it. I have never found a satisfactory solution of the difficulty myself, or at least one that I was satisfied with and would like to learn of methods used that have given satisfactory results. It is often impracticable or not of economic benefit to construct ditches with a uniform gradient owing to the topography of the country and the problem of preventing the silting up of the ditch with a broken grade line becomes an important one. Any information that you can give me of methods that have proven successful will be appreciated.

B., ———, Mo.

The problem would not be difficult should conditions remain the same, for each stream, natural or artificial, ultimately takes care of itself and equalizes its flow in volume and velocity and the engineer needs only to guide this natural tendency into lines which will interfere as little as possible with the effects he wishes to produce. But the conditions are quite different when the ditch is running full from those when it is at low water, and so constant vigilance is necessary to prevent breaks in grade are necessary. A sudden damage to the drainage system, in case the break in grade produces an acute condition which is difficult if not impossible to control. A gradual reduction in grade distributes the difficulty over a larger distance and so the trouble is not so insistent at any one place and will not require so constant attention, but when attention is demanded the amount of work to be done will be increased much in the same proportion that the time between cleanings is increased. However, it is possible, sometimes, so to concentrate the flood flow on these sections where trouble is expected that it will do at least part of the moving of the previously made deposits. The branch ditches sometimes prevent the best treatment on the line, but if they are as high as the question suggests, they may be made to add their help by proper design of the junctions of side ditches with main ditch. It is quite possible, by curves, changes in cross section, lengthening of grades near outlets, tangential admission of flow of side ditch into main ditch, etc., to reduce the velocity of current in the side ditch at the entry into the main ditch at least to that in the side ditch proper at a distance from the outlet, and so cut out the acute difficulty directly at the junction. Occasionally it may be necessary to make the difficulty as acute as possible and establish a permanent plant for cleaning the ditch at such point, which can then be worked at a maximum of economy.

Each drainage engineer and constructor has his own practical methods of treating this problem and MUNICIPAL ENGINEERING invites its readers to contribute to the pleasure and profit of this correspondent and many other readers by sending descriptions of special devices used and the success attained and statements of principles which they consider established by the facts they have observed.

Water Supplies by Compressed Air.

Kindly let me know if you have anything in air pressure water system. I am installing one now and there is talk of them not giving satisfactory work.

H. K., Emmetsburg, Ia.

The writer knows of no plant which is entirely successful and all of them are, necessarily, small. The only available source of information seems to be the manufacturers of the plants. Will our readers give us some information based on their own experience or refer us to persons who will give it?

How to Measure Water Supply Furnished City.

I am in need of information as to how I can accurately measure the flow of water furnished by our pumping station for city use. Our conditions are as follows:

The water is pumped from the river to the reservoir a distance of 4,000 feet through a 12 or 16-inch pipe. The elevation of the reservoir is approximately 150 feet above the water in the river. The water is then transmitted by gravity to the city through a 16-inch pipe with a fall of 50 feet or more.

What I desire to know, can a weir be placed along this line, or at any point, that will obtain correct results. If so, where can I get the information as to how to construct such weir.

If there is any other method by which we can obtain the above results I would certainly feel under obligations to you if you will advise me of the same.

If you know of any cities that are working under similar conditions that are using some method of measuring the water pumped I would be glad if you will advise me of same.

M. B., ———, Kan.

The simplest measurement can be made over a weir if the connections of the inlet or outlet pipes are such that a weir can be inserted at inlet or outlet. The standard weir is described in all modern books on hydraulics, and the methods of construction, of making observations and of computing results are fully stated. The weir will have the most uniform flow over it if it is placed at the outlet of the reservoir, and the determinations of the flow will therefore be the most accurate. The data given in the question are not sufficient to warrant any suggestions as to methods of constructing the outlet chamber so as to make all the water pass over the weir on its way to the outlet pipe.

A Venturi meter placed in the main supply pipe will give a permanent means of keeping a record of the variations in the flow of water to or from the reservoir, according to whether it is located on the inlet or the outlet pipe.

Some of our readers may be willing to describe any temporary or permanent installations which they have made for the purposes mentioned, whether of weirs, meters or other devices.

Water Rates in Small Cities.

If you have published the cities and villages having water works, specifying which is municipal and which is private, in the states of Indiana, Ohio and Kentucky, of populations under 10,000, it would be of particular interest to me as I am interested in a rate revision in a plant in this state and the average rate in this case cannot exceed, according to the franchise, the average rates of cities of the fifth class in Indiana, cities of the fourth class in Kentucky and villages in Ohio. Kindly advise anything that you have published relative to rates and ownership of properties that would be of any assistance and apply to my case.

R., ———, Ind.

According to the latest available list, the cities and villages in the states named having populations between about 3,000 and 10,000 are the following:

Indiana: Municipal plants: Alexandria, Attica, Auburn, Bedford, Bloomington, Bluffton, Brazil, Columbus, Connersville, Decatur, Dunkirk, Fairmount, Garrett, Gas City, Goshen, Greenfield, Hartford City, Huntington, Kendallville, Lebanon, Madison, Martinsville, Mishawaka, Montpelier, Newcastle, Peru, Plymouth, Portland, Rochester, Rushville, Sullivan, Tipton.

Private plants: Aurora, Crawfordsville, Frankfort, Franklin, Greencastle, Greensburg, LaPorte, Lawrenceburg, Linton, Mt. Vernon, Noblesville, Princeton, Seymour, Shelbyville, Valparaiso, Wabash, Warsaw, Winchester.

Kentucky: Municipal plants: Bowling Green, Cynthiana, Danville, Lebanon, Ludlow.

Private plants: Ashland, Bellevue, Dayton, Earlington, Frankfort, Georgetown, Hopkinsville, Madisonville, Mayfield, Maysville, Middlesboro, Mt. Sterling, Paris, Richmond, Shelbyville, Somerset, Winchester.

Ohio: Municipal plants: Alliance, Ashland, Athens, Barberton, Bellaire, Bellefontaine, Bellevue, Bridgeport, Bryan, Cambridge, Canal Dover, Collinwood, Coshocton, Crestline, Cuyahoga Falls, Delphos, Eaton, Elyria, Fostoria, Fremont, Gallipolis, Greenfield, Greenville, Hillsboro, Kenton, Lakewood, Lancaster, Lisbon, Logan, Madisonville, Martins Ferry, Middletown, Mt. Vernon, Napoleon, Nelsonville, Niles, Norwalk, Norwood, Oberlin, Painesville, Ravenna, Reading, St. Bernard, St. Mary, Sidney, Toronto, Troy, Van Wert, Wapakoneta, Wellston, Wellsville, Wooster.

Private plants: Bowling Green, Bucyrus, Circleville, Conneaut, Defiance, Delaware, Dennison, Gallon, Jackson, Kent, London, Marysville, New Philadelphia, North Baltimore, Pomeroy, Salem, Shelby, Uhrichsville, Upper Sandusky, Urbana, Warren, Washington C. H., Xenia.

Following are some of the rates for metered water reduced to the common price of cents per 1,000 gallons. While very few of the cities and villages in the list are using meter rates to any large extent, and only one or two exclusively, the two columns for municipal and private plants may be compared with interest. The column of maximum rates gives the price of interest to the ordinary citizen. The column of minimum rates gives the rate offered to large consumers, ordinarily for manufacturing purposes, and often indicates, especially in municipal plants, the concessions which the city is willing to make to such large users for their benefit to the city generally.

INDIANA METER RATES.

Municipal.	Max.	Min.
Huntington	25	10
New Castle	10	8
Peru	20	15
Portland	25	7
Private.	**Max.**	**Min.**
Greencastle	40	15
Greensburg	35	15
Mt. Vernon	50	20
Noblesville	160	60
Seymour	40	sp.
Wabash	40	20

KENTUCKY METER RATES.

Municipal.	Max.	Min.
Bowling Green	25	13
Danville	50	sp.
Ludlow	25	14
Private.	**Max.**	**Min.**
Frankfort	15	sp.
Hopkinsville	30	10
Paris	25	16
Shelbyville	30	10
Winchester	25	16

OHIO METER RATES.

Municipal.	Max.	Min.
Ashland	20	8
Athens	30	8
Bellefontaine	15	3
Canal Dover	20	6
Coshocton	20	6
Eaton	20	13
Elyria	15	8
Fostoria	20	sp.

Greenville	8	8
Hillsboro	30	10
Logan	30	8
Madisonville	40	8
Martins Ferry	30	10
Mt. Vernon	20	15
Napoleon	15	10
Niles	40	10
Norwood	40	8
Oberlin	30	20
Painesville	30	13
Ravenna	15	5
Reading	30	8
Van Wert	30	7
Private.	Max.	Min.
Bucyrus	25	sp.
Circleville	30	15
Defiance	40	sp.
Delaware	25	sp.
Dennison	35	15
Galion	25	sp.
Kent	15	9
London	25	16
Marysville	25	sp.
Salem	30	8
Shelby	25	sp.
Warren	35	10

The flat rates are not so readily compared, as they vary so much in items and combinations of items. Some attempt at a comparison is made in the following table. The family rate is computed for a family of five or a house of 7 or 8 rooms, with the usual fixtures for which extra charges are not made, and does not include such extra charge fixtures as water closet, bath tub, wash bowl, horse and carriage and hose. The family rate is reduced as nearly to a comparable figure as is possible under the variations in charges. The rates for the extra charge fixtures are taken directly from the rate cards. All the rates are in dollars per year. The rate for hose or lawn sprinkling varies much in basis for charge and is assumed for a lot 50x150 feet in size and made to apply to this standard lot as nearly as the statement of the rate will permit.

INDIANA FLAT RATES.

City	Family	Water Closet	Bath	Bowl	Horse	Hose
Municipal Plants.						
Alexandria	4.00	1.50	2.00	0.50	1.00	6.00
Connersville	3.00	1.50	2.00	1.50	2.00	3.00
Huntington	6.00	2.00	2.00	0	1.00	.....
New Castle	.....	1.50	2.00	0.50	1.50	.....
Peru	6.50	2.00	2.00	0	2.00	4.00
Plymouth	3.00	2.00	2.00	....	1.00	3.50
Portland	4.00	3.00	4.00	2.00	3.50	4.00
Private Plants.						
Greencastle	7.50	5.00	5.00	4.00	3.00	5.00
Greensburg	8.25	3.00	3.50	1.00	3.00	7.50
Mt. Vernon	8.00	3.00	4.00	....	2.00	.....
Noblesville	6.50	5.00	5.00	0	3.00	5.00
Seymour	7.25	3.50	3.00	....	10.00	8.00
Wabash	8.00	3.00	4.00	....	2.00	5.00

KENTUCKY FLAT RATES.

Municipal Plants.						
Bowling Green	12.00	3.00	3.00	2.00	.....	8.00
Danville	8.00	4.00	4.00	0	7.50	8.00
Private Plants.						
Frankfort	7.00	3.00	2.50	1.00	4.25	.....
Hopkinsville	6.00	5.00	6.00	5.00	4.50	5.00
Paris	6.00	4.00	4.00	2.00	5.00	6.00
Shelbyville	7.00	4.00	4.00	2.00	5.00	5.00
Somerset	8.00	6.00	5.00	3.00	.....	.....
Winchester	8.00	4.00	4.00	....	5.00	6.00

OHIO FLAT RATES.

Municipal Plants.						
Ashland	4.50	3.00	3.00	3.00	3.00	5.00
Athens	5.00	3.00	3.00	0	3.00	5.00
Bellaire	8.00	2.00	3.25	....	.....	.....
Bellefontaine	4.00	2.00	2.00	0	3.00	.....
Bryan	4.00	3.00	2.00	....	2.00	.....
Canal Dover	7.00	2.00	3.00	0.50	2.00	2.00
Coshocton	7.00	2.00	3.00	0.50	2.00	3.00
Eaton	5.00	2.50	2.50	0.50	3.00	met.
Elyria	8.00	3.00	3.00	....	1.50	5.00
Fremont	6.00	2.00	3.00	0	2.00	0
Greenville	4.00	2.00	3.00	....	1.50	5.00
Hillsboro	5.50	2.50	2.50	....	2.50	.....
Logan	4.00	2.00	3.00	0	2.00	8.00
Madisonville	6.00	2.50	2.00	1.00	2.50	3.00
Martins Ferry	9.00	3.33	3.33	1.00	.....	7.50
Mt. Vernon	6.50	2.00	2.00	0	2.00	4.00
Napoleon	4.00	2.50	4.00	0	2.00	5.00
Niles	8.00	3.00	3.50	....	3.00	.....
Norwood	5.50	2.50	2.00	1.00	3.00	3.00
Oberlin	5.00	3.00	3.00	....	3.00	7.50
Painesville	8.00	4.00	4.00	4.00	5.00	Sp.
Ravenna	5.00	2.00	2.00	0	2.00	2.00
Reading	5.50	2.50	2.00	2.00	1.50	.....
Toronto	7.00	3.00	4.00	....	3.50	.....
Troy	5.00	2.00	2.50	2.00	3.00	.....
Van Wert	5.00	3.00	3.00	....	2.50	5.00
Wapakoneta	5.00	2.00	2.00	0	1.00	3.00
Private Plants.						
Bucyrus	7.00	3.00	3.00	0.50	2.00	5.00
Circleville	7.50	2.00	....	....	2.50	.....
Defiance	8.00	3.00	5.00	1.00	2.50	5.00
Delaware	7.00	3.00	3.00	....	3.00	37.00
Dennison	6.50	5.00	3.50	1.00	3.00	5.00
Galion	8.00	4.00	4.00	1.50	3.00	6.00
Kent	6.25	2.50	2.50	1.50	.....	.....
London	6.75	3.00	3.00	....	2.50	5.50
Marysville	6.00	3.00	3.00	....	3.00	5.00
Salem	5.00	1.00	3.00	1.00	2.25	5.00
Shelby	8.00	4.00	4.00	1.00	3.00	.....
Xenia	6.75	3.00	3.00	....	2.50	5.50

These data are taken from the last edition of the "Manual of American Water Works" ($3) and a few changes may have been made since the date of report, but in the main the rates given are correct.

It is evident that no definite result can be obtained from a consideration of these figures. When one considers the differences in the actual cost of furnishing water under the greatly varying conditions in the places named, it becomes evident that the rates cannot be uniform.

When a small city or village is desirous of securing a water works plant and cannot raise the money to build the plant itself, it may be very desirable to pay a company a rather large price for taking the risk and the trouble of putting in a plant and building up a business. So far as immediate concessions are concerned, the municipal authorities and the company can make their bargains with full knowledge on both sides, but if the contract ties the municipality up for a long period of years or in perpetuity and makes it impossible to modify its provisions as conditions change, then the municipality is paying too dearly for its improvement. The first schedule of rates may very well be tentative and subject to change up or down, as may be found necessary, at the end of five or ten-year periods, that they may be kept as nearly equitable to both sides as is possible. The water company being in every sense but one a public corporation, and doing a public service, it is only just to require such publicity or official knowledge of the business and accounts of the company as shall make it possible to fix the rates so that they shall produce a liberal return upon the money invested, but no more.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited.
Give from your experience for the benefit of others.
Never mind style of composition, the fact is what is wanted.

Concrete Base for Steam Railroad Track.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Referring to request of "City Engineer" and of yourself for information regarding concrete foundation for steam railroad track carrying heavy traffic, in a recent number.

The Union track lying in Division street, Evansville, Ind., connecting the E. & T. H. R. R. and L. & N. R. R., lies along the center line of a brick street, carries heavy freight and passenger trains, being the transfer track between the above railroads over which all of their common Chicago-Florida and Chicago-New Orleans trains pass; and is supported by a concrete foundation underneath the ties.

This track had cost at least $350.00 per year for maintenance (a little over one-half mile long) and was then in poor condition practically all of the time, owing to bad subgrade and leaky water pipes lying just beneath the surface.

There is much heavy hauling along this street and it was, at times, almost impossible to cross from the brick paving on one side of the track to the other with a loaded wagon. Citizens remonstrated, newspapers printed news items and even gave the condition of the track editorial mention.

In 1908 an attempt was made to put the track in good condition by planking it solid at a considerable expense. This made the raising of joints a very difficult matter and was otherwise unsatisfactory.

In 1909 an experiment was made with a concrete foundation under two blocks as shown on attached plan. (Lower one in figure.) Twelve inches of concrete, 9 ft. 6 in. wide, was placed under the track and a 6-inch curb run up to top of ties, so as to make it monolithic with the base. A 5-inch layer of broken stone and screenings was placed under the ties and the spaces between the ties and between the rails was filled with broken stone and screenings. Crossing plank made a continuous driveway from the outside of the rails to the brick paving of the street.

During the winter of 1909-1910 a 10-inch snowfall in Evansville blocked the through trains until the snow had all been shoveled off the plank-covered portion of Union track and the planking, which was heaved by the frost, had been taken up.

This planking was later replaced, but many of the boards were bad and the condition of the track as bad as ever.

The experimental two blocks stood this snow and frost so well that it was decided to improve the remainder at the earliest possible opportunity.

Dull business and a change in management delayed the matter until autumn of 1910. In spite of the lateness of the season work was begun on November 8, 1910.

An attempt was made to hold the track up on switch ties laid beneath the ties and parallel to the rails while excavation was going on. This method was used for the two blocks between Main street and Heidelbach avenue, but it proved too inconvenient and expensive. West of Main street car line crossing the track was thrown onto the brick paving along the north side of the street and ballasted up there. Nearly all of the industry sidings were put out of service. The Ninth and Reid street car line was not in service and as there was already a concrete foundation under the crossing, the track was cut on both sides of the crossing frog and connected up alongside. This left the old road bed clear for work and dirt was thrown upon and material unloaded from cars of the work trains, which were kept alongside all the time, excepting while passenger trains used the tracks. Freight trains, whenever possible, were detoured via Belt Railway, so as to give work trains more time.

When the excavation was completed the concrete gang followed up with two mixing boards and placed 12 inches deep by 9 feet wide of concrete mixed 1 part cement to 6 parts of a rather poor mixture of sand and gravel pumped from the railroad company's pit at Emison, Ind. Concrete was carried out under switch ties of turnouts to heel of frog only.

The mixing and placing of the concrete foundation was the only part of the work, except setting of curbing, that was done by contract, all other labor was regular section and extra gang labor.

The mixing ((all by hand) was done very rapidly and not always thoroughly, but always wet. Thin ice often formed on the water covering the concrete in the mornings.

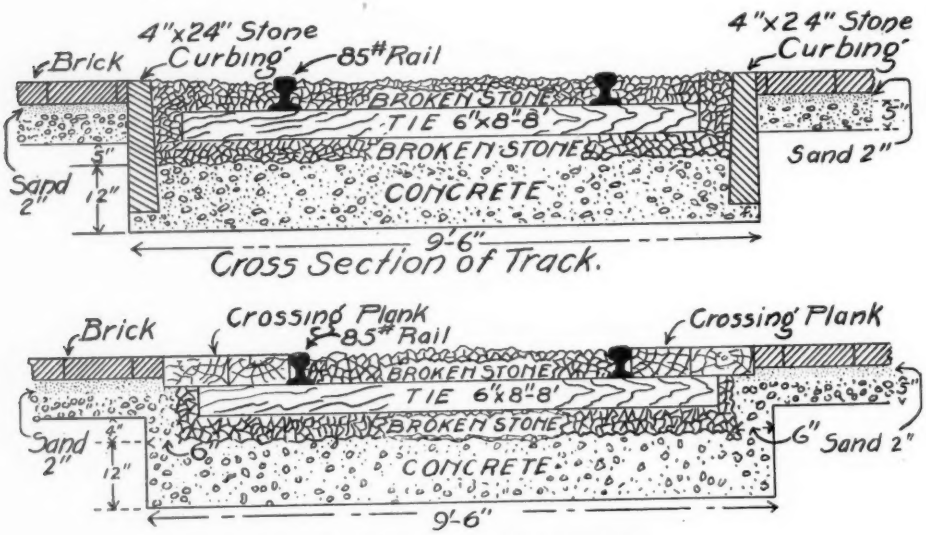
In spite of this it made a very fair concrete. Few faults have been discovered though no expansion joints were put in and it showed up a very good concrete where pieces had to be removed to make room for stone curbing.

About a week after concrete had been placed, new ties were laid, new 85-lb. rail spiked to these and the track partly ballasted. The old track was 70-lb. rail and that was taken into stock as relay rail. Very few of the old ties were in condition to use again.

The new track laid, the setting of the curbing was begun. The curbing was set upon the brick pavement on one side of the street, and by detouring all except the fastest freight trains have already been mentioned. The city authorities required one side of the street kept open for vehicles, so it was not possible to store materials on the street.

The track was put into service when concrete had set 21 days.

The entire length of the track underlaid with concrete in 1910 was 2570 feet, at a total cost for labor and materials (not including new ties and new heavier rail), of $9,000.00.



UPPER SECTION FINALLY ADOPTED.
LOWER SECTION UNSATISFACTORY ON TRIAL.

flush with the top of the pavement and 4 feet 6 inches from center line of track to near side of stone. At first 18 and 20-inch Kentucky limestone was used for curb. This was later changed to 20 and 24-inch. (No reason is given for using more than one width and 20 and 24-inch pieces were jointed together). It was all 4 inches thick, tamped up on limestone screenings 4 to 6 inches deep and the brick paving back of it together with the concrete foundation under the brick replaced and a neat cement grout poured over and swept between the bricks.

Owing to the advanced season, there was much difficulty in getting the quarries to furnish stone for curbing and ballast. The quarrymen could not work when it rained or snowed and would not work when there was frost. It took a goodly number of bright days and much exchange of correspondence, long distance conversation and telegrams to get the work completed by March 1st.

The difficulties in excavation, keeping track open for passenger trains and for work trains by means of a temporary track thrown

Labor was plentiful at 15 cents per hour. Foremen were paid $60.00 per month.

DETAILED COST.

Grading, 1,500 cu. yds. at .60.....		$900.00
Concrete Base, cost per cu. yd.		
Labor	$1.26	
Water	.11¼	
Cement	1.40	
Gravel and sand.....	.30	
	$3.07¼	
About 900 cu. yds. at $3.07¼.....		2,765.00
(Contractor was allowed 21 sq. yds. extra for concreting to heel of frog of each turnout from main track.)		
Stone Curbing,		
2,570 lin. ft. of 18 and 20-in. at 32 cents.....$	822.00	
2,570 lin. ft. of 24-in. at 39 cents	1,002.00	
Freight average 5 cents per ft.	257.00	
Curb setters at 4 cents per ft.	206.00	
Curb setters help at 2 cents per ft.	103.00	
5,140 lin. ft. cost.....		2,390.00

Ballast, 1,150 cu. yds. 1-inch and under white and blue limestone at $1.12	1,289.00
Labor, Ballasting and constructing new track and throwing, ballasting and taking up old track at 50 cents per ft.	1,285.00
Labor, Replacing concrete foundation under brick, replacing brick and grouting	371.00
Total	$9,000.00

Railroad and city officials and citizens generally are well pleased with the condition of the track and it is thought that the improvement is permanent.

J. G. BERGER, C. E.
Mt. Vernon, nd.

Best Pavement for Steep Grade.

To the Editor of MUNICIPAL ENGINEERING:

Sir—The question department of MUNICIPAL ENGINEERING for March, 1911, contains the following:

What, in your opinion, is the best material for a street improvement from a safety point of view, with a grade of 10 per cent? What is your opinion of bituminous macadam pavement for a grade of this kind? Do you think it would have a tendency to wash?

HARVEY STREET, PAWTUCKET, R. I.
Bitulithic Pavement on 12 per cent. Grade. Macadam Street in Foreground.

Perhaps one of the best ways to answer this question is in the light of experience and I therefore submit the following:

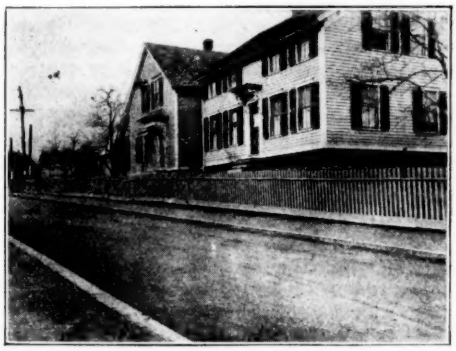
Harvey street and Park Place, in this city, were the first streets upon which a bitulithic pavement was ever laid. This pavement was put down in June, 1901, and today, ten years later, both streets are in very good condition.

On Harvey street the grades are as follows: 227 ft. of 4.9 per cent, 180 ft. of 7.4 per cent, 160 ft. of 12 per cent.

On Park Place the grade is comparatively flat and is only referred to in this connection because it was one of the first pavements of this kind to be laid.

The pavement on Harvey street has always afforded a good foothold for horses and has never washed.

I enclose two photographs of this street which are of interest as showing its present condition. They were both taken in January, 1911, and for the purpose of showing the



HARVEY STREET, PAWTUCKET, R. I.
Bitulithic Pavement on 4.9 per cent. Grade.

difference between a macadam surface and a bituminous macadam surface after a heavy winter rain.

This is partially illustrated in photograph No. 1, by the rutty, muddy character of the ordinary macadam street at the foot of Harvey street, and in photograph No. 3, on Broadway, where a short section of bitulithic pavement is shown, just in front of the two horses, and where the remainder of the street is macadam covered with a pasty mud. This short piece of bitulithic was placed in Broadway at the intersection of two falling grades, to facilitate the draining of the street to the catch basins.

In photographs No. 1 and No. 2 can be seen the mosaic character of this pavement, as shown by the surface of the stones which catch the high-lights.

Photograph No. 1 is of a 12.0 per cent

BROADWAY. PAWTUCKET R. I.
Macadam Street with Short Section of Bitulithic.

grade and photograph No. 2 of a 4.9 per cent grade. Harvey street has never had repairs made upon it.

GEO. A. CARPENTER, City Engineer.
Pawtucket, R. I.

Competition in Public Contracts.

To the Editor of MUNICIPAL ENGINEERING:

Sir—I have read with special interest the editorial in your July issue regarding and liberally extracting from Major Gilette's paper on the above subject prepared for the American Society Engineering Contractors, and also the full paper published by the Society, and am pleased to respond to your request that your readers add to the discussion.

I quite agree with Maj. Gillette and others in discussion of the paper that the American Society of Engineering Contractors is the organization which should take the initiative in practical correction of the evil.

I cannot entirely agree with Maj. Gillette's prescription for a cure. I believe more can be accomplished by placing even greater responsibilities upon public officials, holding them to a strict accountability for their proper exercise, and then providing adequate means for the detection, exposure and correction of any abuse of the powers which may be entrusted to them. It is, in my judgment, a serious mistake to attempt to make men honest by the passage of laws which on their face assume that all men are dishonest. I believe our laws at present are generally based too little on the fixing of individual responsibility and too much on suspicion of general dishonesty of public officials and an effort to force honesty by legal safeguards—a result which I believe can never be accomplished. If more responsibility, confidence and discretion were placed in our public officers, we would find more high class citizens ready and glad to take public office for the honor it carries and the good they can accomplish.

The first fundamental error, as it seems to me, in the article, is the effort to eliminate by legal enactments the element of personal liability and responsibility of both the public official and the private contractor.

The second is the failure to recognize the necessity of having two distinct kinds of competition—that between different things answering the same general purpose and that between bidders for the same thing.

The third is an entire misapprehension of what is meant by and what can be accomplished through competitive bidding, and the failure to realize that in the last analysis there can be competitive bidding only as to the percentage of profit for which one contractor is willing to undertake the work as compared with another, unless it be that the public is willing to take its chances in securing the work to be properly done where it is known that the contractor takes the contract for less than cost.

Every contract is made up of three items—labor, materials and profit. Assuming the cost price of the first two to be approximately the same, there is only room for competition as to the profit to be made.

The above suggestions naturally raise the question as to whether we have not reached the point where the principle of doing business on the competitive basis is not out of date and where we must look for the correction of abuses to publicity and the general elevation of the moral tone of business, and a higher order of integrity and efficiency in all public servants, coupled with the elimination of the political "Boss" in its generally accepted, and rather uncomplimentary, sense and recognize that every organization, political or otherwise, must have a leader who may in the case of public service be honest and work to the public good.

Let us proceed on the theory that all men are born honest and that most men would prefer to remain so and generally will remain so if encouraged to give the best that is in them and if given a remuneration for service which is consistent with their effort and responsibility and which will enable them and their families to live as people in their stations should live and, in addition, save a reasonable amount. This applies with equal force to contractors as well as public officials. How many engineers and other executive officials in our small or even large communities who are expected to devote their entire time to the work are paid salaries which are so small as to be entirely inconsistent with the positions they hold, the results they are expected to accomplish and the expenses of living in a way such men should live to be a credit to themselves and the public? How frequently does it occur that the public is pleased when there is evidence that a contractor has taken a contract at a low price—one which cannot yield a profit and will surely yield a loss if honestly administered?

Is not the whole system of competitive bidding and award of contracts to the lowest bidder (regardless of responsibility, including previous experience in the line of work undertaken, evidence of honesty of purpose or otherwise and of the profit or loss on the work) based on the wrong principle of grinding the contractor down to a basis on which he cannot live and carry out his contract honestly ruinously excessive competition in other words?

Do not such conditions as to both officials and contractors breed and encourage, if not almost force dishonesty on the part of both?

In any reform we undertake let us assume that officials (engineers or otherwise) as well as contractors are honest and place in the officials the responsibility and the confidence which that assumption would carry with it. Then pay the officials fair salaries and you will generally get good service, although at times in public as well as private life there will be an occasional wrong-doer.

Let the contractors understand that their bids will be as readily rejected if too low as if too high and that experience, responsibility and general reliability in the past will weigh as heavily in determining the award as the amount of the bid in dollars and cents. Would any of us if we were to build an expensive house hire an architect

who would work at the cheapest rate and then advertise for bids and say to the contractors—"The man who offers to do the work for the least money and gives a surety company bond will get the work?" What kind of a house would we get on that plan? In such cases do we not consider price as only one of the many important factors for consideration in awarding the contract? Who has ever heard of satisfactory result through surety bond after the contractor has failed because the contract price is too low?

THE SPECIFICATIONS.

As Maj. Gillette forcibly states, the specifications should be clear and distinct and as brief as practicable. They should avoid all trick clauses and at the end of every paragraph should state under what item of the contract and bid the work embraced in that paragraph is to be paid for. "Discretion of the engineer" should be eliminated and yet some things must be left to the "best judgment" which is another way of stating "discretion" of the engineer, but its exercise should always be fair. Too often the engineer considers his duty is to get all he can for his employer, however unfair to the contractor. In such cases it is only to be expected that the contractor will do his best to "recoup" and the engineer who is so narrow as to take unfair advantage of the contractor is generally sufficiently dense so that the contractor can find a way to "put one over" on him.

THE UNBALANCED BID.

As Maj. Gillette says, this is the most potent means of exercising dishonesty. It is only made possible through unbalanced quantities of the engineer's estimate, whether the error in estimate is due to dishonest design, to incompetence, or to undue haste or lack of care in making the estimate. Even contractors with an honest purpose are pretty apt to avail themselves of an opportunity to "unbalance" their bids if the estimate offers the opportunity, knowing that even if they do not "unbalance" some one or more of their competitors are pretty certain to see the opportunity and avail themselves of it.

Let contracts provide that if any item of a contract exceeds 20 per cent of the estimated quantity the excess shall be done at cost of labor and materials plus fifteen per cent regardless of the contract price for such item, and let the engineer understand that when any item exceeds the estimated quantity by more than 20 per cent the fact will be regarded as prima facie evidence of incompetence and be followed by rigid investigation and probable discharge, if the investigation proves the error to be due to either incompetence or dishonesty. Then, at least intentional unbalancing of bids and estimates will be promptly stopped and engineers will exercise more care than they often do at present.

In some cases the quantities cannot be accurately estimated in advance and in such cases the "cost plus fifteen per cent" basis of payment for the excess will check dishonesty. Never put in a contract a clause that if certain unanticipated contingencies arise the work "will be done by the contractor without extra allowance." Nothing could be more unfair, for instance, than a clause in specifications for a pavement that if "soft or springy places develop in the sub-grade they shall be dug out by the contractor and refilled with sound material (earth, stone, cinders or concrete) as the engineer may direct without extra charge." Yet this is a common clause in pavement specifications, and equally unreasonable and similar clauses are found in specifications for other classes of work.

If the contractor, in the construction, is faced with such a condition, he is sure to know he has been "robbed," and if he doesn't retaliate by "stealing" some cement out of the concrete or otherwise it will be because he doesn't know how—not because he is dishonest, for he will be pretty certain to figure out in his own mind that, under the circumstances, such retaliation is honest. In every construction unforeseen contingencies are liable to occur. It is absolutely dishonest to throw the extra expense on the contractor and specifications should always provide for such cases, that such unanticipated or unforeseen work shall be paid for at "cost of labor and material plus fifteen per cent" or, as is the custom of the city of Toronto and some other cities, include in the specifications and contracts a long list of unit prices generally accepted as fair and reasonable which will be the measure of pay in case such unanticipated work is required. The cost and percentage basis is the more fair for both parties because a schedule of unit prices cannot be made which will be fair to all cases regardless of quantity or other conditions of the unforeseen work.

RELATION OF ESTIMATE TO CONTRACT.

Maj. Gillette suggests that no bid should be accepted if the price of any item exceeds the engineer's estimate by more than 10 per cent. Such a system would too much encourage engineers to make unfairly low estimated prices or to force the using of an incompetently prepared estimate as the final basis of contract. I have known cases where such a system was in vogue and on which, from my knowledge of costs, I believe the engineers systematically estimated about 5 per cent below actual cost in order to entice the unwary contractor and get low bids. In such cases you may be sure the contractor will "work his wits" to get even and I believe, generally speaking, will succeed in accomplishing the end at the expense of more or less poor work and still consider himself honest. So long as contracts are based on such lack of confidence and fairness between the contractor and engineer, so long will there be dishonesty in carrying out of contracts. Employ only competent engineers; pay them fair salaries; treat the contractors fairly, yea, honestly, and I believe 90 per cent of

the rascality in public work will be removed.

It is often customary to estimate a nominal quantity and receive unit prices for classes of work of which some may he required but the engineer cannot tell where, or definitely, if any nor how much will be required. For instance the estimate may have an item "10 cubic yards concrete" and the bids for that item are sure to be high. Is it not far better to state that if any concrete is required it will be paid for at "the actual cost of labor and materials plus 15 per cent?"

A case recently came to my attention in a country road contract which contained the general provision that the price of no item shall exceed 10 per cent of the engineer's estimate. "Grubbing and clearing" was described as usual and paid for at a lump sum. Either through dishonesty, lack of study of the situation or incompetence the engineer did not estimate there would be any grubbing and clearing," but provided an estimate of "grubbing and clearing lump sum $1.50." The contractor could bid 10 per cent. advance or $1.65. He "guessed" that the engineer knew there would be no grubbing and clearing and with only three days' time to read the specifications, travel 200 miles to look over the site and get back with his bid and bond and with no stakes showing exact location of the work, he could not check the item. In full confidence of the accuracy of the engineer's estimate he did not avail himself even of the 15 cents excess the contract permitted him to bid but bid the exact amount of the estimate—$1.50. If he had bid $1.66 his bid would have been illegal, informal and rejected. When he came to do the work he encountered a great many trees and stumps, some quite large, and his "grubbing and clearing" cost him $700. The contracting board was "sorry" but could not "go back" of the contract and the contractor was "milked."

I may have a wrong conception of the word "honesty" but in my judgment it was just as dishonest for that engineer to make the estimate as he did as it would have been for the contractor to have used four parts of sand to one of cement when the specifications call for three to one in the concrete. When the engineer doesn't know where the material is to be used it is unfair and dishonest to provide either a unit or lump sum price in the bid to cover such unanticipated construction.

PATENTED ARTICLES.

When any patented article is embraced in any construction or the use of any patented machinery is required the engineer should require the owner of the patent to file with the contracting board an agreement to furnish the patented article or machinery to any responsible contractor at certain definite terms and such agreement of the patentee should be embodied or at least referred to in the specifications.

If it be suggested that the owner of the patent has it within his power under such a proceeding to favor one contractor by offering to furnish his patented material or machinery at a less price than that stated in the agreement filed with the contracting board, this could only be done by the owner of the patent depriving himself of the royalty which he would otherwise receive, and is no more than the owner of any manufactured product or material, such as brick, asphalt, wood or granite blocks, could do by offering to furnish the material called for by the specifications to one contractor at less price than that furnished to another, while the inducement to favor one contractor at the expense of another is less necessary in the case of the owner of a patent than it is with the manufacturer or owner of other materials required to be used in the construction.

EMERGENCY WORK.

Maj. Gillette proposes to absolutely tie work in excess of $100 to formal contract made after ecareful preparation of specifications and advertisement to run sufficiently long time for contractor to become familiar with the work and the contracting board to canvass bids, etc.

Suppose a break occurs in the Erie Canal. It might cost $5,000 to repair immediately but if left for contract the damages and cost of repair might exceed ten times that and we come back to the statement with which I opened that we must consider that our officials are honest and give them such discretion as the honest conduct of their offices demand to the best good of the public service. I believe that with a good deal more confidence in public officials, the public would be far better served.

SUGGESTED LAWS.

Commenting on Maj. Gillette's suggestion for amendments to laws governing public contracts, I think it is a great mistake to have the State Legislatures pass laws which limit or regulate public service in matters on which the local officials are or should be more conversant and the administration of which necessarily depends on local conditions to a greater or less extent. In my humble judgment we already have too much rather than too little general law regarding public contracts and that the hands and reasonable discretion of our public officials are already tied too much.

The duty and responsibility of local self government should not be attempted to be taken away from municipalities by general acts of the Legislature, which cannot possibly be familiar with the local conditions about which it undertakes to legislate.

Referring more particularly by corresponding numbers to the clauses of Maj. Gillette's proposed law, I would comment as follows:

1. As noted above the absolute requirements that all work in excess of $100 shall be done by public contract is impracticable, at least in case of emergency. If "emergen-

cies" are excepted from the law it opens the legal question of whether or not any particular case is an "emergency." In my observation and experience, as a rule, cities are best and most competently, and apparently most honestly governed when the officials are given wide discretion to do work either:

a. By public letting after advertising for bids which they will generally adopt.

b. By private contract after negotiation without advertising for bids.

c. By direct purchase of labor, materials and equipment.

2. Engineers' estimates of cost should, as Maj. Gillette suggests, be "filed in the office of the public official who invites the bids" and I would add "and included in the notice to contractor and specifications and available to the public and bidders."

3. The suggestion to advertise sufficiently before the letting and in enough papers to give due notice to contractors is good.

4. Definiteness of specifications and contracts is well put by Maj. Gillette. I see nothing in this clause, including its subdivisions "a" to "k," which does not seem to me to be good.

Regarding paragraph 1 (at the bottom of page 21 of the Society proceedings). As indicated above, I think the contracting board should not be tied to any percentage of the engineer's estimate, either in total or in particular items. I believe the public will be better served if the public officials are assumed to be competent and honest and the responsibility placed on them as such.

5. The letting of contracts should not be limited to "citizens of" and "corporations doing business in" the state. If so limited why not go farther and limit to residents of the city or ward. Every responsible contractor experienced in the work to be undertaken should be free to bid everywhere.

6. I heartily agree with Maj. Gillette's recommendation regarding the public opening of bids and rejecting of bids having erasures.

7. Bids should be opened on time or rejected unopened. As above stated, I don't believe in the inviolable rule of acceptance of the "lowest bid" and believe the public service can be most efficiently administered by permitting discretionary latitude to public officials, always holding them legally responsible for an abuse of the discretion, and requiring them in awarding a contract to another than the lowest bidder, to state publicly their reasons for awarding the contract to the bidder selected.

8. I do not agree with Maj. Gillette's suggestion that there is now any necessity for broadening the right of legal procedure to inquire into the legality of contracts, as the courts are now and always have been open to any general taxpayer to contest the validity of any contract awarded by a public official, and instead of broadening in any way the legal right to inquire into the validity of contracts, I would suggest restricting the right of any property owner or taxpayer to allow the use of his name for the purpose of contesting the validity of the legal proceedings where it can be shown that the suit has been brought in good faith, and that the property owner has been indemnified against all legal liability for the use of his name by some rival or disgruntled contractor who for spite or other selfish reason seeks to tie up the prompt execution of public work, and that all such suits should be promptly dismissed by the court where these facts are proven.

9. The clause fixing responsibility of inspection is good.

The basic error of Maj. Gillette's paper is the assumption that all public officials are dishonest and that laws can be framed to prevent dishonest officials from robbing the public. Laws cannot make men honest—they can only punish their misdeeds when detected, throw restrictions around the opportunities for fraud, and afford the public an opportunity to be relieved from their effect when detected. Laws have never yet and never will make men honest or elevate the moral tone of business or secure freedom from "graft" where dishonest public officials owe their selection or appointment to the political "Boss," who, under existing laws, is able to "deliver the goods." Instead of attempting to enact laws which assume upon their face that both public officials and contractors are dishonest, thereby suggesting to them a means of avoiding the effect of the laws, while apparently complying with their provisions, I suggest that we proceed upon directly the opposite assumption, and merely undertake to provide by laws for the prompt publication of every purchase made by any public official, giving the nature of the purchase; the name of the party supplying the article; and the price, quality and quantity purchased, where practicable; the general nature of every contract to be let; and when let the name of the contractor and price paid, and also to provide in the same publication for a monthly statement of the cash receipts and disbursements made by all public officials, and for the public criticism in the same publication of all acts of public officials, where such criticism is made over the signature of the party making the same. Public sentiment is at last the tribunal before which the conduct of all public officials must be tried.

In conclusion, I believe the province of this association is in an effort to mold popular opinion and official action rather than in enlisting in the passage of more or less complicated laws which should be a matter of local consideration and responsibility of local officials and taxpayers, and to finally treat the matter from the point of view that both contractors and officials are to be trusted and considered honest but watched, publicly exposed and promptly discharged or prosecuted if found "wanting" in the proper exercise of the trust committed to their keeping.

GEORGE C. WARREN,
Boston, Mass.

MUNICIPAL MATTERS IN COURT

Higher Courts—City Cannot Sell Water Outside.

Decisions of the Higher Courts of Interest to Municipalities.

Limitations of Assessments for Public Improvements.—An act provides that the assessment for local improvement shall be paid in annual installments not to exceed 25 per cent. of the assessed benefits in any one year, and that no single improvement shall be undertaken which alone shall exceed in cost 20 per cent. of the value of the real property in the district as shown by the last county assessment. *Held,* that where a street improvement required an expenditure of more than 20 per cent. of the value of the property in the improvement district as shown by the last county assessment, but by reason of contributions from the county and city, much less than such 20 per cent. limit would have to be assessed on the property, the improvement was authorized.—McDonnell et al. v. Improvement Dist. No. 145 et al. 133 S. W. 1126.

City May Locate Manholes in Sidewalk.—A city may have sewer catch-basins located in the sidewalks, unless the plan adpted is inherently dangerous; and the fact that the surface of the basins was of smooth iron, so as to be more slippery than if made of wood or corrugated iron, was not negligence, so as to make the city liable for injuries to one slipping thereon.—McCourt v. City of Covington (Ky.), 136 S. W. 9101.

Municipality Is Not Dissolved by Reason of Military Occupation or Territorial Cession.—A municipal corporation is not totally dissolved as a mere consequence of military occupation or territorial cession. The present city of Manila, reincorporated by the Philippine Commission with substantially the same municipal powers, area, and inhabitants as the Spanish municipality of the same name, is liable upon municipal obligations incurred prior to the cession of the Philippine Islands by the treaty of Paris of December 10, 1898, to the United States. A debt incurred for coal to be used in a municipal waterworks system is a municipal obligation, although the municipality holds property and funds in trust to be devoted to the establishment and maintenance of said system.

A Water Company's Charter Constitutes a Contract.—A water company's charter constitutes a contract between the company and the city served which the city cannot alter without the company's consent. Where rates charged by a water company can be changed only by agreement between the company and the city, the company will be restrained from charging an increased rate agreed to by the city on condition that no meter rental charge be made, where the company refuses to abide such condition.

Substitution in Specifications by Authority of an Official May Not Be Made After Contract Is Let.—Suit by a city on the bond of sewer contractors to recover the expense of repairing broken tile was sufficiently covered by instructions that use of fine earth, instead of sand, in laying pipe, would not entitle the city to recover unless the defective condition complained of was caused by such substitution, and that no city officer could authorize the substitution.—City of St. Louis v. Rueching et al. (Mo.), 134 S. W. 657.

City Not Liable for Loss Under a Rescinded Contract.—The damage suit of David McCormick against Henry M. Scales, former mayor, and the City of Oklahoma City, for $50,000 damages has been decided in the Federal Court of Oklahoma in favor of the defendant. McCormick is a paving contractor of St. Louis and was awarded paving contracts in this city amounting to more than $500,000. After the contract had been awarded, the council rescinded its action, whereupon McCormick entered suit against the mayor and the municipality. The amount sued for, $500,000, was the prospective profit on the contract.

City Liable for Work by Independent Contractor.—A city cannot escape liability for damage caused to abutting property through a defective plan of street construction, because the work was done by an independent contractor.—Potter et ux. v. City of Spokane et al. (Wash), 115 P. 176.

Right of a Property Owner to Surplus Earth from Street Improvements.—Where, in the case of a street improvement, an abutting owner is entitled to surplus earth removed from the street, and he desires to exercise the right to remove it for his own use, he must act promptly in asserting the right and, where he fails to remove the soil, he must be deemed to have abandoned his right thereto.—Sinker-Davis v. City of Indianapolis et al. (Ind.), 94 N. E. 886.

Municipality May Not Supply Water Outside of the City Limits.—A municipality,

owning and operating a waterworks plant, has no power to supply water to persons living outside the municipality; and such power does not result by necessary implication from the power of the municipality to supply water to its own citizens.—Steitenroth et al. v. City of Jackson (Miss.), 54 S. 955.

City May Employ Associate Counsel—Compensation.—A city may employ associate counsel to assist its city attorney in any case where its authorities deem it necessary. The bond given in an unsuccessful injunction suit against a city covers the reasonable amount necessary to compensate special counsel to assist the city attorney in defending the suit.—Vicksburg Waterworks Co. et al. v. Mayor and Aldermen of Vicksburg, (Miss.), 54 S. 852.

Right of a Water Company to Refuse Service on Account of Non Payment of Debt.—A contract by a public service water company to supply water to a consumer, which provides that it may shut off the water for non-payment for 15 days of water bills, and that it may require payment of all water rents and charges as a condition to again supplying water, refers to water rent and charges for supplying water under the contract, and the company may not, as a condition to restore water service, demand payment due for water supplied at a previous time and different place.—Benson v. Paris Mountain Water Co. (S. C.), 70 S. E. 897.

Right of Municipality to Condemn Property for Water Works.—The statute authorizing the city to pass ordinances for the protection of land used for water purposes outside of the city limits, it had power to condemn land for water works purposes located outside of its corporate limits. The compensation awarded for land condemned is determined by its market value, and in determining such value the adaptability of the land for a particular purpose may be considered, together with its probable demand for that purpose, especially if it be unusual, so as to affect the market value, but uses which are so speculative as not to affect the market value cannot be considered.—Edwards et al. v. City of Cheyenne et al. (Wyo.), 114 P. 677.

Consequential Damages for Condemned Land.—Commissioners and experts in valuing land condemned to widen a street could consider it as a whole, and were bound to give the full value of the land actually taken with any consequential damages resulting to the land remaining. In determining the consequential damages to remaining land resulting from condemning land to widen a street, the commissioners could consider that the street had been increased in width, thus increasing the easement of light and air, and the general desirability of the property along the street. In re Roebling street in City of New York (N. Y.), 127 N. Y. S. 944.

Contract to Supply Water Outside of City Limits May be Terminated at Will.—The council of defendant city granted complainants the privilege of connecting with the city water mains and the use of city water at their residences outside the city limits, provided the city ordinances were complied with, one of which authorized the supply of water to persons outside the city who should enter into a contract with the city containing a reservation by the city of the right to terminate the contract on 30 days' notice. Complainants without entering into any formal contract, made connections with the city mains at their own expense, and alleged that, in reliance upon representations by the city that they could obtain a water supply, a new house was built. *Held*, that the city was not estopped by any representation or by complainants' expenditures from terminating the agreement on 30 days' notice.—Childs et al. v. City of Columbia (S. C.), 70 S. E. 300.

City Has No Right to Enforce Public Service Rate Reduction.—In the absence of a delegation thereof by the Legislature, express or necessarily implied, a municipal corporation has no power to regulate or control rates for public service, such as the furnishing of water, gas, or electricity, or the terms and conditions of contracts therefor, otherwise than by contract with the corporation or person rendering such service.—Bluefield Waterworks & Improvement Co. et al. v. City of Bluefield et al. (W. Va.), 70 S. E. 772.

Right to Tap City Water Mains Is Not a Franchise.—The water purveyor of a city gave plaintiff the privilege of tapping the end of a city water main, and at its own expense to lay the pipe from the end of the main to its premises to supply itself with water. *Held*, that the permit so granted was not a franchise, as a franchise can only be granted by the legislative body of the city, and hence the levying of a special franchise assessment upon the line of pipe by plaintiff was unauthorized.—Peope ex rel. Peter Cooper's Glue Factory v. Board of Tax Commissioners (N. Y.), 127 N. Y. S. 992.

City Not Liable for Unforeseen Accidents Due to Natural Causes—Distinction Between Judicial and Administrative Functions of a City.—In an action against a municipality for damages to land caused by a slide of earth in opening a road where defendant had the services of a competent engineer, and, in running the cross-section lines to determine the amount of cut and fill, he examined the ground where the improvement was to be made, and prepared specifications thereon, and no slide had ever been known in that vicinity, and he was never informed of the existence of a fissure therein, his judgment respecting the plan was all that reasonably could have been required from an inspection of the conditions, and the city was not liable. A municipal corporation in devising plans for improving public highways within its borders acts judicially, and, when proceeding in good faith, is not liable for errors of judgment, but in constructing the work it acts ministerially, and must see that the plan is executed in a reasonably safe and

skillful manner.—Giaconi v. City of Astoria (Or.), 131 P. 855.

Use of Patented Material Does Not Limit Competition in Paving Awards.—The statutes relating to towns and cities, provides that a board of public works shall let a contract to the lowest and best bidder; section 8710 relates to the determination by voters or by the council of the kind of material to be used in a street improvement. A corporation having patent rights in a paving material called bitulithic proposed to grant to the city, or to any accepted bidder for paving work, the right to use it for a specified royalty, conceded to be reasonable, the city to have the use of such right for repair of pavements for which the contracts were let during 1908. The city accepted the proposition and after a petition under section 8710, requiring the use of bitulithic, prepared specifications calling for bitulithic paving, specifying that the rights conferred by the company were granted to any contractor at the same rate. *Held*, in an action by a taxpayer to enjoin the letting of the contract, that the use of the patent rights provided in the specification was not an interference with the competition contemplated by the statute.—Tousey v. City of Indianapolis et al. (Ind.), 94 N. E. 228.

City Not Responsible for Misinterpretation of Specifications.—Where contracts for the construction of sewers were based on carefully drawn plans and profiles, showing grades, etc., drawn to a scale with the horizontal and vertical scale plainly marked thereon, the contractors bidding were bound to determine the quantity of work required by the plans and specifications themselves, and were not entitled to rely on a mistake in interpretation thereof procured from the office of the city engineer.—Hanrahan et al. v. City of Janesville (Wis.), 130 N. W. 482.

A City May Not Sell Water Beyond Its Own Boundaries.

The city of Reading, Pa., owns and operates a water works system which comprises six sources of supply, six storage reservoirs, a distribution reservoir, a pumping station and supply or distribution lines.

Of the six sources of supply, five are gravity supplies; the sixth, the Maidencreek supply, being pumped into the reservoirs, etc., and furnishing all the water needed for consumption over and above that yielded by the other supplies.

The latter yields an average daily supply of about 6,087,000 gallons, while the consumption is about 12,276,000 gallons per day. The proportion pumped from Maidencreek is about one-half.

The quantity of water carried by Maidencreek is greatly in excess of the average daily consumption as well as the capacity of the storage and distribution reservoirs. In pumping water from Maidencreek and in collecting from gravity supplies more water than is needed for daily consumption is pumped and collected. There is, in other words, always a daily balance of water in the reservoirs over and above what is required to meet the daily consumption. But in order to utilize the whole of what the various sources of supply are capable of furnishing, the city would be obliged to increase its storage facilities and pumping.

The Glenside Water Company was incorporated for and is engaged in the business of selling and furnishing water to the inhabitants of Bern township, and the Reading Suburban Water Company was incorporated for and is engaged in the business of selling and furnishing water to the inhabitants of Muhlenberg township, both townships adjoining the limits of the city.

About the beginning of April, 1903, the Board of Water Commissioners of the city of Reading, without previous authority from the city councils, entered into contracts with the above named companies, to be in force for ten years and contemplating renewals for a further like period, permitting them to make attachments to the city's water mains and thereby obtain the supplies of water needed by them in their respective businesses, the companies to pay for these supplies at rates lower than those charged to residents of the city. The attachments were accordingly made within the city limits, and the companies used the water of the city and resold it to their consumers outside of the city.

The Reading Suburban Water Company, also by permission of the water board, took water from the Maidencreek supply main, belonging to the city, by connections therewith beyond its limits, and sold the same to certain of its customers outside of the same.

An injunction was sought to prevent the selling of water to persons outside of the city limits, but upon the rates being raised to conform with those paid by the residents of Reading, the injunction was withheld. Later suit in equity was entered and a decision was rendered in favor of the Reading consumers.

The conclusions in this decision were, briefly, as follows:

The city of Reading has no power to sell or sanction the sale of any part of its water for consumption beyond its boundaries.

The Board of Water Commissioners of the city of Reading had no power with or without the consent of city councils to enter into contracts they made with the Glenside Water Company and the Reading Suburban Water Company, or either of them.

The supplying of water by the city of Reading, or its Board of Water Commissioners, to the said companies is an unlawful misappropriation of the property of the city.

The plaintiff is entitled to a decree declaring said contracts illegal and void, and permanently enjoining defendants and all and every of them from performing said contracts, and from selling and supplying or receiving and reselling water of the city of Reading; said injunction, however, to become operative only on and after August 1, 1911.

ROADS AND PAVEMENTS

California Macadam—Chicago Boulevards—British Dust Problem—Allegheny County Highways—Georgia Roads—Dust Prevention Experiments.

Macadam Roads in California.

In commenting on the reason why macadam roads in California are not of the best Mark R. Daniels, C. E., calls particular attention to the defects in construction. These are given at some length in the San Francisco Bulletin and are briefly summarized as follows:

Primarily, the macadam road must withstand the pressure of a load concentrated at four points, namely, the points of contact of the wheels with the road surface. It is evident that no matter how dense and hard may be the road covering, if the soil beneath be soft, sooner or later the road will give way and a rut will be formed at these soft places.

For this reason the surface of the ground is cleared of all organic matter, soft places filled with good solid material and the surface rolled, tamped and treated until it becomes sufficiently hard and firm to withstand the traffic. This is called preparing the sub-grade. Since the character of the work here done is soon hidden by subsequent work, it is, like the political organization which gives it being, generally rotten.

But it is quite evident that while the subgrade may be sufficiently firm to uphold the load, it will not, if composed of earth alone, withstand the wear of traffic. So a hard surface substance must be found to perform this service.

Broken stone immediately suggests itself. But broken stone will not serve the purpose unless held together and in place.

Experience has taught us that the best material is the finely crushed particles of stone, which, when wet, make a very good bonding material.

When such a road is built, each factor takes its place in the equation, as follows: The sub-grade supports the actual weight, although it will not do so unless properly prepared. The coarse, hard rock withstands the attrition of the wheels and tires, while the stone dust and screenings maintain the coarser rocks in their relative position, thus acting as a binder.

On the sub-grade thus prepared are spread the materials for macadamizing. This is the point where the errors in method are so apt to creep in.

The method most commonly used on this coast is as follows: First, a layer of clean, coarse rock of a size which will pass through a two-inch ring, is spread upon the prepared sub-grade, four to six or eight inches thick, depending upon the amount specified. Upon this layer of coarse rock is spread a course, two to four inches, of fine rock or screenings.

The entire road is then saturated with water, when it is rolled until it becomes hard and firm. Let us now investigate the condition that obtains under such a method of construction.

In all bodies of broken rock there is perhaps about 30 per cent. of voids. The object in distributing screenings over the surface of the first course or layer is to supply a finer material which will fill the interstices of the broken stone and act as a bond, as before explained.

But in order to do the work properly the finer material must fill all the voids.

With the present form of construction, however, the finer material is spread upon the top of the coarse rock and wetting and rolling is resorted to to drive this material into the interstices of a six to eight-inch layer of coarse rock. Such a thing is manifestly impossible.

It is true that a thorough saturating with water will tend to wash into these voids or interstices a larger percentage of fine material, but in no instance where I have made tests have I found all the voids filled.

The consequence is that the road presents a very smooth and even surface, which lasts just long enough to be accepted, when the loose support of the lower course begins to shift with heavy burdens, causing a rut, which, once started, like the rings created by the pebble in the pond, enlarges ever.

If the screenings, stone dust and all the finer materials were mixed throughout, or if the crusher run, as it is called, were used, a condition of no voids would obtain.

And yet we continue to construct roads in the manner dictated by the quarry men and contractors without stopping to analyze the problem or ascertain the cause of so many failures.

There are two reasons. One, that it is a cheaper form of construction; the other, that it saves materials. Both of which benefit the contractor.

It is often contended by contractors that the screenings on top will wash and roll in sufficiently to fill the voids that are not filled by the forcing of the earth up from the sub-

grade, but this is rarely true, and it is my opinion that no substantial macadam can be laid without using sufficient fine material well mixed with the broken stone to fill the voids.

Boulevard Improvements in Chicago.

The Chicago plans commission at a recent meeting adopted "Plan No. 3" for the improvement of Michigan boulevard, the Chicago river and Pine street.

"Plan No. 3" contemplates the widening of Michigan boulevard from Randolph street to the river, the construction of a new bridge at Pine street and the continuation of a double-decked boulevard and teaming street, connecting the north with the south side by way of Pine street, as far as Ohio, and a continuation of a widened boulevard as far north as Chicago avenue.

According to these plans Michigan avenue north of Randolph street to the river will be widened to 130 feet. Just south of the present approach to the Rush street bridge a teaming center will be created in the form of a plaza about 222 feet square. Branching off from this will be about five driveways, providing five routes to which teaming may be diverted. Just across the bridge, on the north side, will be another plaza of this sort, to serve a similar purpose. Over here the existing tracks of the Northwestern railroad will have to be met and encountered, but the present plans do not take them into consideration any further than they are taken into consideration by the surface traffic of the present day.

There is a slight change in the grade, but it is said by the engineers of the commission that these grades are made only with a tentative purpose, so that at some time in the future a change in grade may do away with these dangerous crossings.

The bridge included in the plan will have a breadth of ninety feet and will be of the general "jack-knife" plan—such as are in use at State, Dearborn, Clark and other streets.

In the widening of Michigan boulevard and Pine street the plan of the commission in "Plan No. 3" is to take sixty-four feet from the east side of the boulevard—giving it its present width to the southward all the way from Randolph street to the bridge.

Diverting from the present bridge at Rush street, the new plan provides for a divergence of the traffic by this "double-decked" route over a bridge connecting with Pine street—one block east of Rush and at present but little used by through traffic south of Ohio street.

On the north side of the river Pine street is to be extended to a general width of 141 feet by the condemnation of seventy-one feet on the west side of the street.

In general, the results of the new plan, when put into effect, would be a straight route across the river from the south to the north side and a general doing away with the present conflict between teaming and light vehicular traffic.

The Dust Problem in Great Britain.

The report of Consul-General John L. Griffiths, London, contains some interesting statistical matter relating to the dust problem in the United Kingdom. The Roads Improvement Association made the investigation and published the results. The information was obtained by circularizing the road authorities in different parts of the country.

In regard to the preparation of the road for treatment with tar, 56 surveyors pointed out the necessity of thoroughly cleansing the road from dust by sweeping it first with machine brooms and afterwards with hand brooms. Other replies, while more general, indicated that the road should be in good condition.

As to the kind of tar used and the price, 134 authorities used crude or ordinary gas tar; 25 used distilled or refined tar; and 6 used oil-gas tar. The prices varied from 2 cents to 8 cents per gallon, the usual price being between 4 and 5 cents. Twenty-nine authorities used specially prepared tarry materials, such as tarvia, tarmite, Clare's patent tar compo and dustabato.

In 33 cases the area treated per gallon of tar was between 3 and 5 square yards; in 99 cases it was between 5 and 7 yards; in 19 cases, between 7 and 9 yards; and in 5 cases more than 9 yards. When specially prepared tarry materials, oil-gas tar, or ordinary tar mixed with oil was used, the average spread to the gallon was greater than when crude or distilled tar was employed.

Asked as to what material was spread over after treatment, 77 authorities replied that they used sand; 37 used small (¼-inch) granite chippings and granite dust; 10 used large (over ¼-inch) granite chippings; 14 used limestone chippings or dust; 8 used slag chips or slag dust; 19 used road grit removed from the road before treatment; and 15 used local materials, such as shingle, pea gravel, cinder dust, etc. In 5 cases no material was placed on the road after treatment. Several surveyors express the opinion that granite chippings are the best material.

As to the method of spreading the tar and the cost, in 84 cases hand spreading was used, while machine spreading was practiced in 49 cases.

The average cost for treating the road surface, including all expenses of preliminary sweeping, tar, sand or other material spread after treatment and labor, varied between 1.4 cents and 6 cents per square yard. The usual cost was 2 to 2½ cents when machine spread and 2½ to 3 cents when hand spread. Where two coats had been given the cost of the second coat was much lower than the first.

In 61 cases the treatment lasted a season, 6 to 9 months; in 54 cases, 12 months; in 5

cases, over 12 months; and in 5 cases less than a season. In several cases when giving the road a second treatment it was necessary to treat only the center of the highway, the sides remaining in fairly good shape. In some districts the treatments lasted two years.

Modern Highway in Allegheny County, Pa.

Until very recently the country road was a dirt road, and even macadam paving was considered a luxury, except in the more populous centers. In New York, prior to fifteen years ago, there was scarcely a road of any description other than natural earth or gravel, outside of the villages and cities. Now, under the supervision of a well organized state road commission, the state is expending $5,000,000 per year in improved road construction. The amount of money expended in improved country highway construction during the past decade has probably equalled that spent for this purpose during the century preceding.

The macadam roads serve their purpose very well for the traffic of pleasure vehicles and farming wagons, but when the automobile began to be used to such an extent, a new condition presented itself, and roads which were destined to be serviceable for four or five years with but little attention began to go to pieces during their first year. Engineers everywhere sought a reliable and cheap preventive for the destructive action of the automobile tires, and innumerable experiments have been made, particularly by applying various bituminous compositions to the surface of the old roads. The results from these applications have met with exceedingly varying results.

With the application of the bituminous cement to the surface of the roadway, there is no certainty of the bituminous cement flowing or penetrating the interstices of the stone and the consequence is that some spots of the pavements have too much bitumen on the urface and practically none between the stones; and in other spots there will be no material to bind the surface particles together, and too much in the body of the surface. It can be readily seen that this method cannot be depended upon to accomplish the result desired, that is to thoroughly water-proof the surface and bind all of the particles of the stone together.

Realizing that the mixing method is the ultimate goal of the experimenters in improved country road construction, Warren Brothers Company, of Boston, Mass., have been experimenting for several years to devise some means by which the satisfactory results obtained with the bitulithic pavement might be applied to a less expensive construction, adapted to the lighter traffic of country roads, and as a result have evolved the "Warrenite Roadway."

The county commissioners of Allegheny county, Pennsylvania, after spending considerable time in investigation, selected the Warrenite roadway for a portion of the Steubenville pike. This pike is one of the main thoroughfares out of Pittsburg, Pa., and is subjected to considerable traffic for a country road. The problem of maintaining this road in a good serviceable condition was an expensive one for the county, on account of this traffic, and also the fact that the road was very narrow, being cut out of the mountain side for its entire length; and in addition to this the road had very heavy grades in places, which varied from 2 per cent. to 8 per cent. for its entire length. The original roadway was built of macadam on a telford base but had a crown of six inches in 14 feet of width, which would be very high for a level road, and was specially so for the hills which existed. The telford base had been in some years, and it was concluded to be a poor policy to disturb it, so in the construction of the Warrenite roadway the shoulders were built up and the depth at the center of the roadway was reduced. In this way the crown was reduced to three inches. The high crown of the original road resulted in confining the traffic to the center of the roadway, which wore down the original macadam pavement to the base in the crown, while the macadam on the shoulders remained practically intact.

In laying the new roadway, two inches of the Warrenite mixture was laid and rolled at the outer edges, and over this for the full width of the road was laid and rolled the two inches of wearing surface. After the surface had been rolled and hardened, the earth shoulders were built up and rolled to meet the new paving and to conform to its contour.

All the materials for the work came in by rail, about two miles from the work, and the mixing was done in a Warrenite mixing plant on the work and was hauled from the machine to the work in two-wheeled concrete carts. This contract was taken by the Standard Bitulithic Company, of New York City, operating under license from Warren Brothers Company. The work was done under the supervision of the county road engineer, Mr. S. D. Foster.

Good Roads in South Georgia.

Several hundred South Georgians, with accredited representatives from fourteen counties, met recently in Waycross, Ga., and organized the South Georgia Good Roads Association, with L. V. Williams of Waycross, president, and eight vice presidents. The association plans for a good roads train after the example of the agricultural college train, which has made two trips around Georgia. Another meeting was held June 29 at Statesboro. It is proposed to use automobiles to designate a number of highway routes through the state.

Experiments in Dust Prevention and Road Preservation.

The report of the U. S. Office of Public Roads on the observations made in 1910 of experiments in dust prevention and road preservative is printed in Circular No. 94 of the department. It includes some additional experimental roads at Ithaca, N. Y., and observations of those constructed in 1909; additional roads at Knoxville, Tenn., Ames, Iowa, Boise, Idaho, Washington, D. C., New York City, and Ridgewood, N. J.; and observations of the experiments at Youngstown, O., Newton, Mass., several places in Kansas, and Bowling Green, Ky.

Ornamental Lights in Hastings.

The first step for an ornamental lighting system for the business section of Hastings, Neb., has been taken by the council in the granting of a petition for ornamental lights in Lincoln avenue, between First and Fourth streets. The property owners have agreed to purchase iron posts for the lights and the city will supply the current to and maintain the lamps. A design for an ornamental standard will be accepted by the council, to be followed in all districts that may wish to adopt the system on the same basis. Each post will support either three or four Tungsten lamps. They will be placed at each corner on intersections and on both sides of the street at the middle of each block.

Investigation of Lansing's Street Illumination.

The committee from the Board of trade, composed of Saginaw business men, visited Lansing to investigate the street lighting and municipal plant at that city.

The committee's report to the board of trade shows that in addition to the 320 electroliers, or poles bearing one and three and five-lamp clusters of tungsten burners for lighting the business district, there are 200 incandescent lights and 303 arc lights.

The entire cost last year of all this lighting, which is a total of 823 separate lights and clusters, or a total of 1,503 lamps of all kinds, was $22,000. The full amount appropriated for street lighting was $25,000, but $3,000 of it was not used.

Saginaw has 391 arc lights in all for which the city pays. This is the grand total of the street lighting, the cost of which is defrayed by the city. The contract price for these 391 arc lights was $23,400 last year. Saginaw pays $60 per light, while at Lansing the cost is apportioned at the rate of $48 per light for arc lamps.

An official of the Lansing lighting and water department also informed Secretary Joseph P. Tracy, of the board of trade, that within a few years the municipal plant expected to be able to sell electricity to the people for lighting at 5 cents per kilowatt hour and make a profit.

Municipal Light in Pittsburg.

In the introduction of his annual report, Controller E. S. Morrow, of Pittsburg, asks for a thorough investigation of the light question with a view to installing a municipal plant large enough to light the entire city. The Controller has just completed an exhaustive investigation of the matter on his own account, and is ready to turn his figures over to the council with which to start its investigation. Director of Public Works Joseph G. Armstrong has also compiled a mass of information that will be available for the investigators, for he, too, believes the subject to be of vital importance to the city and one that should be taken up immediately.

According to the controller's report there are now in use in Pittsburg 4,000 arc lights, for which the city pays $70 a year each, and 1,000 more for which a charge of $90 each is made, the latter being in cases where current is furnished through conduits. Of course, the average cost from the conduit source of supply must include the additional cost of installing the conduits, which, according to Director Armstrong's figures, is very great.

The estimate for a single lamp on a plane of the magnitude of a plant for the size of this city is about $62 per lamp. His figures take into account depreciation, change of machinery and appliances, interest, taxes and every item entering into the total cost of production and maintenance. At this figure there is a possibility of the city saving $40,000 or $50,000 a year, and proportionately as the city grows.

The cost per lamp of operating the municipal plant in the former city of Allegheny is interesting in this connection and Director Armstrong has gone deeply into that phase of the matter. According to the annual reports of the Northside plant, the arcs maintained by the city cost $7 a year less than those contracted for with the light company.

Mr. Armstrong referred these figures to experts, who have declared that the head of the Allegheny plant has not charged himself with a number of items, including water, haulage, taxes on the property occupied and several other items. If these were added to the total cost, it is asserted that the cost of each lamp lighted from the little municipal plant would amount to $83.49, or almost $13.50 in excess of the contract light.

Mayor Magee is interested in the figures compiled by his works chief and those of the controller. He is known to favor the ownership of public utilities, but to have some decided views as to the advantages to be gained by the municipality operating them, believing that there are many obstructions to the city's ability to operate as cheaply as a private corporation. For instance, the city has to contend with the eight-hour law, the civil service, the fixed price of $2 a day for labor and other items that do not cut any considerable figure with a private corporation.

GARBAGE AND REFUSE

Montclair Garbage Disposal—Cleveland Garbage Plant—Bowling Green Sewage—Milwaukee Refuse Incinerator.

Garbage Disposal in Montclair, N. J.

Conditions at the Montclair garbage dump on the Garretson farm in Upper Montclair, which less than a year ago was condemned by the State Board of Health as being unsanitary and a menace to the health of the nearby residents, have been changed.

In fact, the Montclair officials to whom the change is due, Engineer Immediato and Garbage Inspector Edmondson, say that no other town in the State, if in the United States, has a system of the same nature. They say further than the only possible improvement over present conditions would be the establishment of a garbage incinerating plant, and even that, in some respects, would be less sanitary.

The two branches of a driveway to the thoroughfares meet about 200 feet from the dump, and it is from this point of intersection that the first view of the place is to be obtained. All that is seen is that the road ahead terminates on a huge stone platform, amply large for turning horse-drawn vehicles.

The farm land slopes to the eastward and the platform, although about on a level with the street, is raised high above the land at the lower end. The contents of the garbage carts are dumped into galvanized tanks.

The carts, which are of iron and covered with heavy oiled canvas, are, after the load is disposed of, driven to the lower side of the dump to a concrete washing platform, where they are thoroughly cleansed. The water from the washing is carried through a drain pipe to a cesspool through the open stonework sides of which it is dissipated into the earth far below the surface. The vehicles used in the collection are sent away from the place absolutely clean.

In Montclair kitchen refuse only is considered as garbage. Ashes, papers, etc., are disposed of in other ways, the ashes being used as filler for low ground and the papers and other dry refuse burned. Because the garbage is kept separate, it is in great demand by farmers as food for poultry and hogs. The agriculturists are willing to pay for the material and drive from long distances to obtain it. The farmers are allowed to have the stuff, but they also are compelled to observe the rules established.

Any one wishing garbage from the Montclair dump must have a tight wagon body, from which liquids will not drip, and a canvas with which to securely cover the load before driving off the ground. Before leaving the dump the farmers must wash the outside of their wagons.

To obtain his load of garbage the farmer drives onto the concrete washing platform at the lower side of the dump.

A trap in the tank is opened and the required material slides down into the wagon.

At the close of each day all material left in the tanks is drawn off into a cart and dumped into a nearby pit. It is then covered with quick lime and about two feet of soil. A hose is then turned into the tanks and they are thoroughly washed, as is also the platform.

The present system of garbage disposal was planned by Mr. Immediato several months ago. Before he could put it in operation, however, considerable work was involved. Trouble was encountered in securing water, as a part of the necessary piping from the street had to be laid over other land than that belonging to the owner of the farm where the dump is located. It was because of this difficulty in obtaining the necessary water supply that the new process was first put in operation only recently. It had been Mr. Immediato's intention to have the system in use before the summer months began.

Prior to the installation of the new system the process employed consisted in emptying the contents of the carts on the surface of the ground, whence it was shoveled into the farmers' wagons. The residue left at night was buried.

Although the greatest precaution was taken to allow no material to remain above ground at night, and quick lime was spread plentifully on the surface of the ground where the garbage had lain during the day, it was impossible to keep the flies away from the place.

To Exhibit Cleveland's Garbage Plant.

A miniature reproduction of the garbage disposal plant and pictures of the group plan probably will comprise the Cleveland exhibit at the International Municipal Congress in Chicago, September 18 to 30. Secretary Munson Havens, of the Chamber of Commerce, was instructed to prepare the display. It was impossible to give city funds for a Cleveland display, so the Chamber of Commerce took it up.

The Milwaukee Refuse Incinerator.

Since the opening of the new refuse incinerator at Milwaukee, Wis., there have been many more or less conflicting reports as to the success of the plant and the economy of its operation. The city department of public works was desirous of ascertaining the facts in the case and has been keeping records for the purpose of making comparisons. The Milwaukee Bureau of Economy and Efficiency has just published the results of a rather extended investigation of the plant and of the methods of operating it, made by the staff of that organization, assisted by the superintendent of the incinerator.

The first difficulty mentioned in the report was in the division of responsibility, the collection of garbage being under the board of health and the collection of ashes and refuse under the department of public works, prior to 1911. The bureau made its first recommendation that the collection be concentrated under the latter board, and during the present year this has been done. Changes in the schedules resulted in economies in garbage collection amounting to $5,130 to May 15 and probably to $8,550 for the year, the amount of garbage being about the same.

Another saving has been made by making the proportion of garbage conform to that for which the furnace was designed. Instead of 50 per cent. garbage and 50 per cent. refuse, the amount of refuse brought to the plant has been reduced until the percentage of garbage in the mixture incinerated has been increased to about 57, a saving of 1,417 tons of such refuse from January 21 to May 15, which is estimated to reduce the cost of destruction some $4,298 for the year. The refuse from the 7th ward is now taken to dumps instead of carrying it to the furnace, the cost of collection and delivery being practically the same in either case and the furnace being thus relieved of the extra refuse with the saving noted.

The differences in proportions of refuse from those for which the plant was designed have made necessary some changes in method of operation, which have increased the number of men employed and consequently the cost of operation. Some changes in form of wagon boxes so as to make dumping easier will also reduce the number of men necessary. Some of these changes have already been made and when the others are made the annual saving in the labor account will be about $5,836.

The plant was designed to utilize the steam and the clinker produced, but no use of them has been made as yet. Tests made by the city engineer and the superintendent of the plant show that, in addition to the power required to run the plant, a minimum of 640 kilowatts of electrical energy is available for commercial purposes, for which a net profit of $36,576 per annum is estimated. The cost of plant for utilizing the steam is estimated at $60,000.

It is estimated that the clinker, by the installation of a crusher at a cost of $2,800, can be prepared for use for foundation concrete and the like at a profit of $7,020 a year.

The dust from the combustion chamber can be sold at $3 a ton at the asphalt plant, it is claimed, and, allowing for delivery, a profit of $1,147 a year on the estimated production of 459 tons is computed.

Of these recommendations some have already been adopted amounting in all to $16,267 a year credit to the plant. Other early reductions in labor force will increase this by $3,964 and when the installations for utilizing steam and clinker are made a further credit of $43,596 can be earned. These all amount to $63,827 a year.

A careful study of the labor cost of incineration is made, based on three months of actual operation under existing conditions. This varies from $1.75 to $1.96 per ton. A "standard" cost per ton is estimated on the basis of the best conditions of operation under the standard existing circumstances, as the "goal toward which effort is to be directed." It is $1.2822 per ton of garbage, of which $0.9152 is direct furnace labor and $0.3670 is indirect labor, including superintendence. This "standard" cost is compared with the cost of $0.7215 per ton of garbage reported at the official test. The difference between the two is accounted for, first by the 36.7 cents indirect labor, above given, and second, by the greater cost of direct labor, arising for the reasons above given and from higher wages. This amounts to 19.37 cents. It is understood that the unnecessary labor of the actual operation is eliminated, according to the recommendations of the report, in producing the "standard" of cost.

The corresponding figures for total labor cost per ton of total refuse incinerated are 39.1 cents for the official test and 76.92 cents for the "standard" of future operation.

The report also shows the computation of other than operating costs for the "standard," viz:

Plant expense	1.72 cents
Maintenance	11.10 cents
Insurance	2.15 cents
Interest, rental, taxes	30.31 cents
Depreciation	30.33 cents

which, with the labor costs given above make the total cost of operating the plant, under the "standard" conditions, $2.1683 per ton of garbage incinerated. The corresponding cost per ton of total refuse consumed is $1.301.

The report contains a text-book of instructions for operating the plant, apparently prepared by Mr. S. A. Greeley, the superintendent, and a full set of forms for daily reports of collections and operation of plant, time sheet, and weekly and monthly statements of operation, finances and products of plant.

The recommendations of the investigating engineers, Prof. L. E. Reber and E. B. Norris, are largely those outlined above. They include one that so long as the products of the furnace are not utilized the col-

lections of garbage and refuse brought to the plant should be such as to consume the garbage at a minimum total cost of operation of the plant. The principal recommendation, however, is that the utilization of the steam and the clinker should begin as soon as possible. When it does begin the plant should be operated with the highest efficiency as a steam and clinker producer in view, second only to the sanitary disposal of the garbage.

Sewage Disposal in Bowling Green.

State Sanitary Engineer Paul Hansen, of Kentucky, has recently completed a survey for the proposed sewer system of Bowling Green. This report gives a detailed presentation of the nature of the problem in Bowling Green, together with recommendations regarding the proposed solution. A brief abstract of the report is given as follows:

The city of Bowling Green has a population of between 9,000 and 11,000. It lies on Big Barren river at the head of navigation. The river, which is a tributary of the Green river, is not much used for traffic, and the city depends almost entirely for transportation facilities upon the L. & N. railroad.

Bowling Green occupies a natural amphitheater formed by a crescent-shaped ridge in the southeastern portion of the city. The slope of the site upon which the city is built is in a general way toward Big Barren river to the northward, but the greater portion of the drainage from the city (and this includes the main business district) is intercepted by a small stream passing through the center of the city.

In former years much sewage entered the ditch, causing it to be exceedingly foul and offensive, but at the present time sewage has been almost entirely eliminated, and such as does enter is subjected to a more or less prolonged period of retention in cess pools or tanks. The result of this treatment is to render the sewage free from the coarser suspended matters, and for this reason its presence in the waters of the stream is scarcely perceptible to the eye. The most objectionable contamination, so far as appearance and odor are concerned, consists of a large volume of soapy liquids from a laundry and wastes from a gas house. Aside from this the stream is exceptionally free from the gross contamination that is ordinarily found in streams which pass through unsewered towns the size of Bowling Green.

The explanation of this lies in the peculiar character of the geological formation, which permits of the disposal of sewage and drainage through subterranean passages. The underlying rock, which in most parts of the city reaches to within a very few feet of the surface, is a very pure limestone which is readily soluble in water containing carbonic acid. The result has been the formation of innumerable channels within the rock varying from very small size to passage ways that may properly be called caverns. These channels are entered from the surface by natural sink holes or through holes drilled or excavated for the purpose. Practically all of the buildings in Bowling Green which have indoor plumbing have connection with one of these sink holes for disposing of sewage. If by this means the sewage could be effectively removed so that it would not appear elsewhere to contaminate wells or emerge at the surface and create offensive odors, the final disposal of the sewage might be considered satisfactory. This naturally endangers the wells throughout the city, so that for a number of years no wells have been used.

The proposed system, as outlined by Mr. Hansen, is substantially as follows:

That portion of the sewerage system contemplated for present installation comprises as its principal feature the main trunk sewer which is at once the most costly and the most important feature of the entire system. It is proposed to divert all of the storm water from the Big Sink, causing it to follow a natural drainage course leading to Big Barren river, about one-half mile distant, and to reserve the Big Sink for receiving sanitary sewage only. This will be accomplished by enclosing the sink with a cancrete structure so designed as to shut off all extraneous drainage. In addition there will be built a screen chamber, in which the coarser suspended solids will be removed from the sewage in order to prevent, as far as possible, a tendency to clogging in the irregular passages to which the sink hole heads. It may be mentioned that sedimentation was also contemplated as a means for removing the suspended solids from the sewage, but it was concluded to be unnecessary at present.

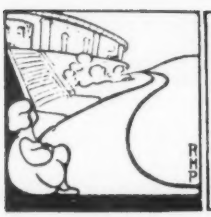
A diameter of 24 inches was adopted for the main outfall sewer as being necessary to meet all reasonable future demands. With the grades obtainable it should adequately carry off the sewage from a population of 25,000 persons. With 25,000 persons contributing to the sewers the total population of the community will be about 30 per cent. greater, or 32,000.

As the system of sewers branches out in various directions the main trunk sewer becomes progressively smaller, and under the plan proposed for immediate construction the main trunk will have a diameter of 12 inches at its upper end.

The cost of the proposed system, including all pipe, engineering, inspection, etc., is estimated at $35,879.

Calgary's Municipal Railway.

Calgary's (Alberta, Canada,) municipal street railway continues to make bi gearnings for the city. In May the system turned over eleven thousand dollars into the city treasury, besides adding more than four thousand dollars to the sinking fund and interest accounts.



ORGANIZATIONS & INDIVIDUALS

American Association for Highway Improvement — Smoke Prevention Association — International Municipal Congress — Calendar of Technical Meetings — Technical Meetings — Instruction in Highway Engineering — Technical Schools — Personal Notes.

American Association for Highway Improvement.

The first convention of the American Association for Highway Improvement will be held in Richmond, Va., September 12 to 15, 1911.

There have been so many first conventions of national highway associations under one name or another in the past four or five years that this announcement might pass unheeded unless particular attention were called to it. Unfortunately most of the conventions held have been national only in name and have been largely promoted for the benefit of special interests or individuals, so that one begins to be suspicious of any convention held in the interests of good roads, unless it is local enough so that the promoters of it are well known and their standing unimpeachable. This condition of affairs is one which has led those interested in the subject from the point of view of the roads rather than of the business interests concerned with their promotion and construction, to form an association on a basis and with a management which shall be truly national, which is well known, and which has no entangling alliances.

With this object in view the American Association for Highway Improvement was formed last winter with Logan Waller Page, the head of the activities of the United States in the promotion of the construction of good roads, as president, and J. E. Pennybacker, formerly one of his trusted assistants, as secretary. This association has already grown to large size and has secured funds enough to put good organizers in the field, to develop the work of the association and to bring about one of the most important objects of the organization, a close cooperation of all the legitimate organizations in the field, national, district, state, and local.

The success of the association is remarkable and insures a most valuable and interesting convention at Richmond in September. The program will be published in the September number of MUNICIPAL ENGINEERING, and meawhile information will be supplied by Secretary Pennybacker on request if he is addressed at Washington, D. C. Those interested in the cause of good roads should make their preparations to attend this convention.

International Association for the Prevention of Smoke.

The sixth annual convention of the International Association for the Prevention of Smoke was held at Newark, N. J., June 28-30. The four sessions were held in the City Hall.

The first session included an address of welcome by Mayor Haussling, of Newark; the transaction of routine business, and the verbal reports of the improvements effected during the previous year.

The Wednesday afternoon session was opened with an illustrated lecture on "The Relation of the Gas Producer to the Smoke Problem," by Prof. R. H. Fernald, consulting engineer in the U. S. Bureau of Mines. The lecture explained in a general way the operation of some of the types of gas producers. The gas producer was advocated as a means of utilizing low quality fuels with a minimum of smoke nuisance. Prof. Fernald referred to a few plants which had been in continuous operation without shut-down for several years as being truly smokeless. He stated that there were now 474 producer plants in the United States, of which 415 were operated on anthracite coal. These, however, were all small plants. Bituminous coal was used in all plants of large horsepower. In conclusion Prof. Fernald spoke emphatically in favor of central station plants and railway electrification as palliatives of the smoke evil.

The next paper on the "Enforcement of the Smoke Prevention Ordinance in New York City," by Dr. Ernest J. Lederle, commissioner of public health, of New York. This paper described the system of inspection, warnings and preferment of charges and gave statistics of the number of arrests and convictions and the amount of the taxes imposed during the past year.

A paper on "Smoke Prevention in Large Power Stations" was presented by Mr. James T. Whittlesey and Mr. Hervey S. Vassar, chief engineer and assistant chief engineer, respectively, of the Public Service Corporation of New Jersey. Mr. Vassar read the first

part of the paper, in which were outlined the difficulties of smoke prevention in the Public Service Corporation's power plants. Attention was directed to the liability of sudden and unexpected variations in the amount of steam required, which variations put a demand upon the plant which it was almost impossible to meet without smoke. Mr. Vassar advocated improved methods of management in the boiler room as the best plan for smoke prevention.

Mr. Whittlesey discussed the experiments which had been tried at the Public Service Corporation power plant in the effort to comply with smoke ordinances. He mentioned as most effective the change which had been made at the Newark plant from bituminous coal to a high-grade semi-bituminous coal, which was practically smokeless when properly used. Mr. Whittlesey exhibited a number of charts showing curves of smoke density measured according to the Ringelman chart. These curves showed that the density of smoke varied considerably throughout the day in an irregular manner. On some of the charts the effect of the coming on of the peak loads could be traced in the increase of smoke. In the discussion of this paper Robert H. Kuss, assistant smoke inspector of Chicago, described a smoke-recording device which automatically made a continuous record of the density of smoke produced by the stack to which it was connected. In this device samples of smoke from the stack were conducted through a tube of small more and made to issue from a narrow slit so as to impinge upon a paper ribbon wound on a drum driven by clockwork.

The Wednesday evening session was devoted to informal discussions on mechanical stokers, steam jet and other smoke prevention devices.

At the Thursday morning session Richard B. Watrous, of Washington, D. C., secretary of the American Civic Association, gave an address on "Smoke Versus City Beauty." He stated that the damage done to property in the United States amounted to $500,000,000 per annum. This included damage to interior decorations and furnishings, as well as to the outside of buildings. He commended the efforts recently made at Pittsburg to reduce the smoke evil, and stated that Pittsburg could no longer truly be said to be the smokiest city.

C. D. Young, assistant engineer of motive power of the Pennsylvania Lines, west of Pittsburg, explained the difficulties attendant upon smoke prevention in railway work. He referred to the frequent necessity of quickly starting up a locomotive which might be standing in the roundhouse with its boiler cold, and to the sudden changes of load put on locomotives in service by change of grade, unexpected starts and stops and the resistance of reverse curves in freight yards, for example. It was not unfrequently necessary for the locomotive fireman to shovel from 5,000 to 6,000 pounds of coal per hour, and this too from a moving platform, which increased the difficulty of the work. Mr. Young then told of the experience of the Pennsylvania Railroad in the use of mechanical stokers.

The discussion on railway smoke was continued at the Friday morning session, which was attended by representatives of the Pennsylvania and Erie Railroads and the Central Railroad of New Jersey. Mr. F. T. Howley, general road foreman of engines of the Erie Railroad, described the Erie's system of instructing firemen, and stated that no railroad was making greater efforts in the prevention of smoke.

The following officers were elected: President, Daniel Maloney, Newark, N. J.; vice president, J. P. Brown, Indianapolis, Ind.; secretary-treasurer, R. C. Harris, Toronto, Canada. The next convention will be held in Indianapolis in September, 1912.

International Municipal Congress and Exposition.

The prospects for the International Municipal Congress and Exposition, to be held in the Coliseum and Armory at Chicago, Ill., September 18 to 30, 1911, are very bright. The handsomely illustrated announcement issued early in June shows a good organization with John M. Ewen at its head, John MacVicar as commissioner general and Edward H. Allen as general manager. The list of delegates already appointed from many cities in the country is large and the exhibits which the cities propose to make are many and attractive. In addition there will be many valuable exhibits made by commercial firms making and dealing in municipal machinery and supplies.

The scope of the exposition covers all lines of municipal activity and is sufficient to interest every citizen.

Information about details can be obtained on application to the officers of the exposition, 1107 Great Northern Building, Chicago, Ill.

Calendar of Technical Meetings.

South Carolina Good Roads Association.—Annual convention at Spartansburg, S. C., August 10-11. Fingal C. Black, secretary, Columbia, S. C.

American Association for Highway Improvement.—First annual convention at Richmond, Va., September 12-15. Logan Waller Page, president, U. S. Office of Public Roads, Washington, D. C.

The International Association of Municipal Electricians.—Annual convention, St. Paul, Minn., September 12-15. Clarence George, secretary, Houston, Texas.

International Municipal Congress and Exposition.—Coliseum, Chicago, Ill., September 18-30. Curt M. Treat, secretary, Great Northern Building, Chicago, Ill.

Fourth International Good Roads Congress.—Chicago, Ill., September 18 to Octo-

ber 1. J. A. Rountree, secretary, Birmingham, Ala.

International Association of Fire Engineers.—Annual convention, The Auditorium, Milwaukee, Wis., September 19-22. James McFall, secretary, Roanoke, Va.

American Society of Municipal Improvements.—Grand Rapids, Mich., September 26-29. A. Prescott Folwell, secretary, 239 West Thirty-ninth street, New York City.

League of American Municipalities.—Annual convention, Atlanta, Ga., October 4-6. John MacVicar, secretary, Des Moines, Iowa.

National Municipal League.—Annual meeting, Richmond, Va., November 13-17. Clinton Rogers Woodruff, secretary, North American Building, Philadelphia, Pa.

Technical Meetings.

The program for the convention of the Ohio Electric Light Association, at Cedar Point, Ohio, July 25-28, included the following papers: President's address, E. H. Bell, Youngstown, Ohio; "Why the Central Station Should Take Over the Isolated Plant," Waldo Weaver, Tippecanoe City, Ohio; "Systematic Central Station Records," O. B. Reemelin, Dayton, Ohio; "Ornamental Street Lighting," . A. Doeller, Dayton, Ohio; "The Utility Law and Its Application to Electric Light Companies," D. L. Gaskill, Greenville, Ohio; "Pumping Water for Municipalities and for Irrigation by Electricity,' B. H. Gardner, Dayton, Ohio; "Report on Insurance Rates for Electric Light Stations in Ohio," D. L. Gaskill; "The Use of Tungsten Lamps in Sign and Outline Lighting," W. B. Gauby, East Liverpool, Ohio; Committee Reports on Meters, Motor Applications and Electrical Transmission.

The organizing committee of the sixth congress of the International Association for Testing Materials has elected Dr. Henry M. Howe president; Mr. Robert W. Lesley, vice president; Mr. H. F. J. Porter, secretary, and Prof. Edgar Marburg, treasurer.

At the regular monthly meeting of the American Society of Engineer Draftsmen, held at the Engineering Societies Building, 39 West Thirty-ninth street, New York, a paper on "The Development of the Automatic Machine" was presented by C. A. Clark, M. E., of Toledo, Ohio.

The North Georgia-North Carolina Good Roads Association has been organized to bring about co-operation in road building in the territory embraced. The following are the officers of the organization: Albert M. Tumlin, Cave Spring, Ga., president, and J. D. McCartney, Rome, Ga., secretary.

It is announced that the proceedings of the Congress of Technology, held in Boston, April 10-11, will be published. The single volume of about 300 pages, which will be sold at a moderate price, will contain the seventy odd technical papers relating to many fields of industry, which were read at the celebration of the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology.

The Maine Society of Engineers has broadened its requirements to admit to membership civil, mechanical, mining, electrical and chemical engineers, surveyors, architects and other persons belonging to a technical profession. The following are the officers of the society: Cyrus E. Babb, of Augusta, president; Walter E. Sawyer, of Lewiston, vice president; Frank E. Pressey, of Bangor, secretary; Harold S. Broadman, of Orono, treasurer. The directors are: E. E. Jordan, of Portland; Philip E. Combs, of Bangor; E. E. Greenwood, of Skowhegan; Moses Burpee, of Houghton, and Charles A. Mixer, of Rumford Falls.

At the annual meeting of the National Firemen's Association, to be held at St. Louis, Mo., September 25, 26 and 27, 1911, the following are some of the papers which will be read: "Fire Apparatus, Past, Present, and a Glimpse Into the Future," by ex-Chief George C. Hale, Kansas City, Mo.; "Should not the chief of the fire department be consulted and apprised of all building permits and have power to compel the cleaning up and building of stairways, etc.? Should not stairways and elevators be built separate, enclosed and fireproof? Should not warehouses and bad risks space be limited to certain sizes and buildings, separated by fire walls, and laws rigidly enforced?" by Captain James Crape, Engine Company No. 19, Chicago, Ill.; "Solid vs. pneumatic tires on motor-driven apparatus from points of speed, safety and ecenomy," by T. E. Smith, Akron, Ohio; "Is the revolving gear or rotary-style pump, or reciprocating or vertical type, as used on steam fire engines, best suited for the motor-driven apparatus of the day, from the points of simplicity of construction, economy of operation and durability of machine?" by Thomas H. Robinson, Washington, D. C.

The New York Cement Show will be held in Madison Square Garden, the recent sale of that property not taking effect until after the date of the show.

Instruction in Highway Engineering.

New graduate courses in highway engineering will be offered at Columbia University next fall, under Prof. A. H. Blanchard, M. Am. Soc. C. E., who was until recently associate professor of civil engineering at Brown University and deputy engineer of the State Board of Public Roads, of Rhode Island. These courses are to be designed for technical graduates who have already had a four years' course in civil engineering. The course has been planned to include the following:

FIRST YEAR.

Processes of Industrial Chemistry.
Dynamical and Structural Geology.
Advanced Highway Engineering.
Materials of Highway Engineering.
Seminary in Current Highway Engineering Literature.

Lectures by Highway Engineers, Chemists and other Experts.
Mechanical Appliances Used in Highway Engineering.
Highway Bridges and Culverts.
Road Surveying, Drafting and Designing.

SECOND YEAR.

Industrial Chemical Laboratory.
Lithology, Petrology and Petrography.
Advanced Highway Engineering.
Highway Laws and Systems of Administration.
Seminary in Current Highway Engineering and Literature.
Lectures by Highway Engineers, Chemists and other Experts.
Road Material Laboratory.
Management Engineering.
Street Surveying, Drafting and Designing.

Technical Schools.

The College of Engineering of the University of Illinois, at the commencement exercises on June 14, 1911, conferred the bachelor's degree in engineering upon 202 men, the master's degree upon nine men, and the professional degrees of Civil Engineer, Mechanical Engineer and Electrical Engineer upon eight, four and five men, respectively. The honorary degree of Doctor of Engineering was conferred upon Mr. Ralph Modjeski, bridge engineer.

Dr. Michael I. Pupin, professor of electromechanics at Columbia University, New York City, has been designated to serve as director of the Phoenix Research Laboratories of the university. In this capacity Dr. Pupin will have general charge of the research work of the department of physics.

Dr. Arthur Stanley Mackenzie, professor of physics at Stevens Institute of Technology, Hoboken, N. J., has been elected president of Dalhousie University, at Halifax, N. S.

Prof. Louis D. Huntoon, M. Am. Inst. M. E., formerly of the department of mining and metallurgy at Sheffield Scientific School, Yale University, has opened an office at 42 Broadway, New York City, as a consulting engineer.

The Illinois legislature, which recently adjourned, appropriated for the support of the State University for two years, following July 1, the sum of $3,500,000, of which about $500,000 is for new buildings. The College of Engineering received specific appropriations for maintenance amounting to $192,000 in addition to $200,000 for a building. The department of mining engineering received appropriations of $35,000 for maintenance and $25,000 for equipment. The legislature also authorized a tax of one mill upon the assessed value of the state for the future support of the university.

Personal Notes.

A. C. D. Blanchard has been appointed city engineer of Lethbridge, Alberta, Canada.

William H. Catin has been named by Governor Dix as superintendent of highways of the state of New York.

August Baltzer has been appointed city engineer of Kenosha, Wis., succeeding Mr. Robert H. Moth, resigned.

Ralph Modjeski, M. Am. Soc. C. E., has been awarded the honorary degree of Doctor of Engineering by the University of Illinois.

Osborn Monnett has been appointed chief smoke inspector of the city of Chicago. Mr. Monnett was formerly western editor of *Power*.

E. B. Cushing has been appointed inspector of public works of Los Angeles, Cal., with a salary of $3,600 a year. The position has only recently been created.

John T. Miller has been appointed chief engineer of public works of the state of Ohio. He succeeds James Marker, recently appointed highway commissioner.

Allen Hazen, of New York, has been retained by the city authorities of San Francisco to advise with them regarding the Hetch-Hetchy water supply project.

Gen. Theodore A. Bingham has resigned his office of chief engineer of the Bureau of Highways, Borough of Manhattan, New York City, to which he was appointed recently.

L. R. Bowen has been appointed engineer of the street department of the city of St. Louis. Mr. Bowen has been engineer for the board of public improvements for a number of years.

George H. Benzenberg, past president of the American Society of Civil Engineers, was awarded the honorary degree of Doctor of Science at the commencement exercises of the University of Wisconsin.

Henry B. Drowne, Assoc. M. Am. Soc. C. E., has resigned as instructor in civil engineering at Brown University to accept an appointment as instructor in highway engineering at Columbia University, New York.

Louis C. Kelsey, M. Am. Soc. C. E., of Portland, Ore., has been appointed consulting engineer to the Oregon State Board of Health, to consult on matters relating to water supply, sewerage and sewage disposal.

Clifford M. Hathaway, Jun. Am. Soc. C. E., has resigned from his position with the Rhode Island State Board of Public Roads to accept a position as assistant engineer with A. H. Blanchard, consulting highway engineer, Providence, R. I.

P. H. Everett, of Lynn, Mass., has been appointed assistant engineer of the Highway Commission of California, at a salary of $2,750 a year. Mr. Everett is the third highway expert which southern California has taken from Massachusetts.

Arthur P. Noyes has been appointed city engineer and superintendent of public streets of Vallejo, Cal. Mr. Noyes was formerly city engineer. The recent adoption of the commission form of government led to the combination of the two offices above named.

H. F. Porter, consulting engineer, New York City, has been selected by the organizing committee of the Sixth Congress of the International Association for Testing Materials to act as its local secretary. The congress will be held in the United States in the early part of September, 1912.

Messrs. Leonard Metcalf and Harrison P. Eddy, M's. Am. Soc. C. E., consulting sanitary engineers, of Boston, Mass., announce that they have opened a branch office in Chicago, Ill. Mr. William T. Barnes, Assoc. M. Am. Soc. C. E., one of the principal assistant engineers of the firm, will have charge of this office.

Charles A. Hague, consulting hydraulic engineer, of New York City, died on June 25. During recent years he had devoted much of his time to the installation of pumping machinery for water works. He was a member of the American Society of Civil Engineers, the New England Water Works Association and the American Water Works Association.

James R. Marker, chief engineer of the Ohio State Board of Public Works, has been appointed state highway commissioner of Ohio. Mr. Marker has announced the following appointments: Deputy commissioners, Clifford Shoemaker, Clyde T. Morris and A. H. Hinkle. Messrs. Morris and Hinkle are now professors in the Engineering College of the Ohio State University.

MACHINERY AND TRADE

Use of Bitulithic in California.

Bitulithic has been adopted for Orange Grove avenue, Pasadena, Cal., after three years' consideration of the kind of pavement to be laid. The boulevard is about three miles long and fifty feet wide, and will be remembered by visitors to Southern California as one of the best and finest boulevards in the state. On this street are the winter residences of many of the most prominent citizens of the eastern and middle western parts of the United States.

New Portable Plant for Road Builders.

To meet the requirements of bituminous macadam road builders the Iroquois Iron Works, Buffalo, N. Y., has designed a self-propelled asphalt-concrete mixing machine, weighing only 10 tons, which has a capacity of 800 square yards of 3-inch material per day of ten hours. The manufacturers believe that this plant, while available for work on a large scale, will solve the problem of profit making on contracts which do not justify very costly outfits. The wheel base of the machine is only 12½ feet, and it can be shipped on a railroad car.

The engine and boiler of the mixer are the same as those of the Iroquois 8-ton roller. Link belt and bucket elevators are provided for both hot and cold material. The dryer is of the revolving drum type with a screen at the delivery end. The steam-jacketed mixing trough, measuring box and asphalt measuring bucket are of the same width, and so arranged that the stone and heated asphalt are delivered together in a broad stream at the rear of the plant, and there forced by the revolving blades through a trough sufficiently high to permit of easy loading to distributing carts or barrows. The engine, boiler, dryer and mixer are all on one level, the platform being formed of 9-inch 15-pound channel. The first two of these machines manufactured were sold last week to Troy (N. Y.) and Baltimore contractors.

Lead Wool for Jointing Water Pipes.

The cast lead joint for water pipe has defects which it has been impossible to overcome, but the newer form of lead wool or shredded lead has eliminated them.

Molten lead cannot be calked the full depth of the joint, the only calking possible being done on the outside after the lead has cooled and this calking cannot possibly be made effective for more than ½ inch. Molten lead must contract or shrink when it cools and therefore the only safeguard against leakage, in fact the entire strength of a cast joint is confined to the ½ inch or less calked lead at the top or outside of the joint.

Lead wool is put up in strands which should be placed in the joint one at a time and each strand thoroughly calked before the next strand is added.

Every portion of a lead wool joint is calked, every ounce of lead adds to the strength of a joint and this must result in a joint much stronger, more durable, more elastic and better in every way than a cast joint. It will stand far greater pressure than can be applied to cast iron pipe and in fact has been subjected to tests of over 2,000 pounds per square inch.

The manufacturers make no claims for lead wool which have not been fully demonstrated by practical test and by results obtained from its use by water and gas companies in this and other countries.

The Consolidated Gas Company of New York has recently placed an order for 100 tons of lead wool.

Attention is called to two important points; the saving of at least one-third of the material and the great saving in repair work as compared with the cast joint now in use.
use. The saving is shown by the comparison of the number of pounds of lead necessary with cast lead and with the lead wool. Thus a 6-inch pipe requires 9 pounds of cast lead per joint or 6 pounds of lead wool as a maximum; a 16-inch pipe requires 30 and 20 pounds respectively; a 36-inch pipe 103 and 65 pounds respectively. About the same ratio is shown in other sizes of pipe.

Lead wool and pneumatic calkers greatly reduce the cost of jointing cast iron pipe. In a recent paper before the American Gas Institute, C. C. Simpson showed that the pneumatic calkers could not be used satisfactorily with cast lead, for they saved no time and the lead could not be calked back more than ½ to ¾ inch from the face of the hub. Greater pressure than that necessary to do this resulted in split hubs. The use of lead wool, however, gave the pneumatic calker its opportunity, and, in addition to the saving

in lead, a saving in time of making a joint resulted, which was about one-third, or a reduction in labor cost from $3.17 to $2.15 average per joint on 36-inch pipe.

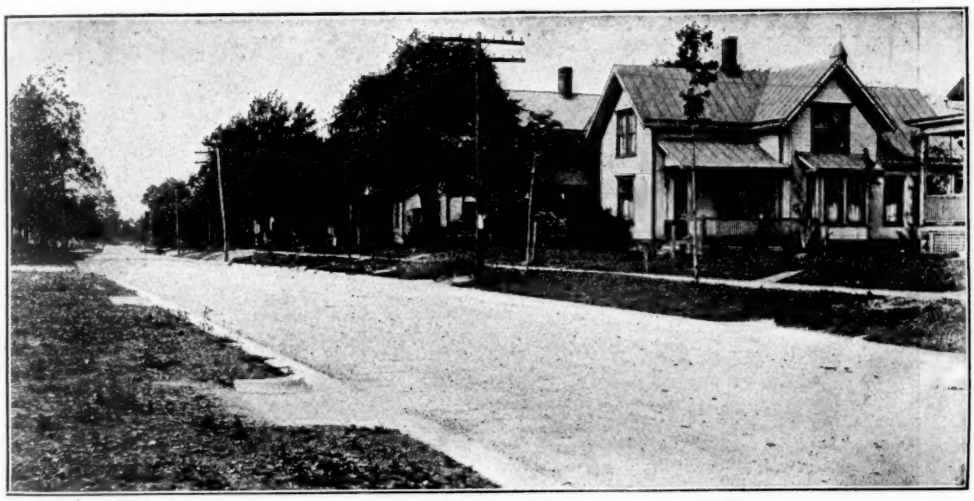
The United Lead Co., Trinity Building, New York City, has some very interesting literature on this subject, including the paper referred to.

The Automobile and the Road.

The first automobiles with their low speeds did little damage to the macadam surfaces, but when speed increased and motors became more powerful the rear wheels of the cars ground the brittle macadam like an emery wheel. Engineers were dismayed to see their costly surfaces, built, as they thought, to endure many years of travel, ruined in a single season. The crushed stone was scraped away by the clinging tires and scattered to the winds by the draft of the cars. The Office of Public Roads in the Department of Agriculture, experimenting on a Long Island highway with high-powered automobiles, settled beyond all doubt that this was the source of the damage when it discovered that the driving wheels of the automobiles revolved considerably more times per mile than front wheels of the same diameter, indicating a certain amount of "slip." The effect of this "slip" on a dry, brittle macadam road surface hardly needs to be demonstrated. The lack of tenacity in ordinary macadam under such strains was responsible for its inability to endure this type of traffic.

It had once been thought that it was the vacuum caused by the passage of the cars which sucked the dust out of the roadway, but with this scientific demonstration to settle the question as to the real cause of the injury, road engineers everywhere turned to the problem of building more tenacious road surfaces. French engineers, years before, had discovered the desirability of binding roads with tar compounds as a dust preventive, and American engineers, following the French experiments, developed what has now become widely known as the tarviating process. The tarvia which is used is a viscid bitumen derived from coal tar. Its function is to fill the voids in the macadam and enclose the stone in a tough plastic matrix. The action is somewhat like that of cement in concrete. The tarvia concrete is not rigid or brittle but retains a certain elasticity and capacity for yielding to strains. On this plastic surface the driving wheels simply roll down the surface and make it smoother with use. They cannot tear loose the stone from the plastic matrix, and they have little or no pulverizing effect.

In appearance tarviated macadam resembles sheet asphalt. It is not designed to withstand the strains imposed on sheet asphalt streets, but it is satisfactory for the lighter traffic of suburban towns, boulevards and automobile highways.



WEST WALNUT STREET, SAYBROOK, OHIO, BUILT WITH TARVIA X.

The tarvia processes, of which there are several, provide the answer to the typical macadam road problems. The problem of maintaining an old and well-worn macadam road, for example, is solved by an application of tarvia B, the lightest and thinnest of the tarvias, designed primarily for dust suppression. This tarvia B process will save an old road for a year, usually making water sprinkling unnecessary, and preventing erosion by water or attrition by automobile traffic.

For more thorough applications there is the tarvia A process, usually employed for roads where a smooth and handsome contour is desired, as in parks, cemeteries, boulevards, etc. Tarvia A is denser than tarvia

B and naturally has more tenacity and bonding power. It is somewhat more expensive, because it is so dense when cold that it cannot be poured and requires the use of heating apparatus to prepare it for application. Like tarvia B, it requires maintenance expenses, makes the roads automobile-proof, and prevents the formation of dust.

The third tarvia process is for new roads or old roads that are being reconstructed or resurfaced. This gives opportunity to use tarvia X, an exceptionally dense and tough bitumen of great durability and bonding power. Like tarvia A, it requires heating for application. The use of the dense tarvia makes possible the placing of larger stones near the surface than would otherwise be possible. Engineers have recognized the desirability of using as large stone as possible at the surface, because large stone is naturally capable of taking more wear than fine stone. Formerly traffic would cause a continuous grinding and turning movement of the large stone so near the surface, just as it causes an old road to ravel and break up when the protective carpet of surface screenings has been worn away. When the tarvia binder is used the large stone can be held firmly to its work near the surface and much more service is thus obtained from the same amount of stone.

Roads built with tarvia X do not change contour even when neglected. They require occasional inexpensive surface treatments to keep them smooth and dustless. Tarvia B is frequently used to good advantage to keep the surface in first-class condition.

In this prolongation of the life of the road lies the real cheapness of the road processes. By these various tarvia processes road engineers have found economical methods of making their roads automobile-proof and these processes are now practically standard among experienced road authorities.

ROAD IN EDGEWATER PARK, CLEVELAND, TREATED WITH TARVIA A.

The Simplex Water Meter.

The Simplex Valve and Meter Co., 112 North Broad street, Philadelphia, have perfected a type of meter which is important for its ability to measure all uows from zero to any desired maximum without limitations.

It consists of some form of orifice such as a Venturi tube, pitot tube in a water main, any form of conduit, canal, or even weir, and having suitable pipe connections with it. The apparatus consists of a mercury float chamber, and resting in which is a float of such variable cross section that its movement is in direct ratio to the flow of water through the Venturi tube, pipe, conduit, canal or weir.

The movement of the float actuates a revolving shaft to which is attached a hand pointing to a fixed dial with uniform graduations.

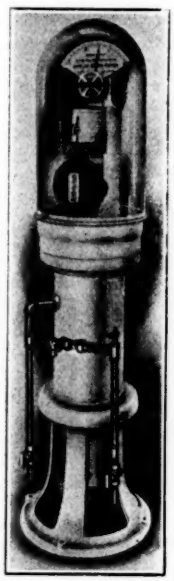
Attached to the shaft and moving in proportion to the angular deflections of it is a pen in contact with a rectangular chart wrapped on a revolving cylinder; also a traction wheel, which passes over the face of a revolving disc, the traction wheel being geared to a train of wheels operating a ser-

ies of small dials similar to that of a house gas or water meter. Both the cylinder and the disc are operated by an eight day marine clock.

The traction wheel is specially constructed so that its movement while in contact with the face of the disc is free from rubbing friction.

It is evident that the movement of the traction wheel, as well as the movement of the pen, being in direct ratio to the angular deflection of the shaft, are in direct ratio to the movement of the float and therefore to the flow of water through the conduit.

As both the disc and chart cylinder are operated by the clock, their angular movements are equal for equal increments of time.



SIMPLEX WATER METER.

The chart is uniformly graduated; the abscissas representing hours and the ordinates the rates of flow.

The total flow register is of the five figure type with small circular dials. For 3-inch to 10-inch Venturi meters inclusive the lowest figure of the dial is 1,000 gallons. For 12-inch to 24-inch inclusive the lowest dial is 10,000 gallons. For 30-inch to 60-inch inclusive the lowest figure is 100,000 gallons. These are for standard Venturi meters whose throat diameter is one-half the diameter of the main. For special sizes the dials are sometimes changed and while the standard is generally taken as United States gallons, the graduations may be in pounds, cubic feet or any other unit that may be specified.

The rate of flow dial, chart, chart recorder and total flow register are all enclosed in a dust-proof glass dome resting on a felt gasket. This feature has the advantage of fully exposing the mechanicism to view at all times, and has been adopted in preference to a metal case, which could just as readily have been used. The accompanying photograph shows one of the meter installations.

The Simplex Company has a booklet which in addition to describing their meters, gives methods for calculating sizes of pipes and tables of diversions.

Non-Corrosive Sheet Steel.

The success on non-corrosive steel culverts has led to the promotion of the non-corrosive metal for other purposes. One of the products of this nature is the "Vismera" sheet of the Inland Steel Company, of Chicago. It is made of very pure steel and thus the danger of corrosion is greatly reduced. The sheets are used in making culverts, roofs, tanks for over- and underground use, siding, eaves and other architectural uses, ash and garbage cans, etc. They are supplied blue annealed, box annealed and galvanized, of standard sizes, and either plain or corrugated.

The Boyd Automobile Combination Chemical Engine and Hose Wagon.

The combination chemical engine and hose wagon, motor propelled, has come to be recognized as the most efficient of all fire fighting equipment. Fire chiefs are almost unanimous in their belief in the value of this piece of apparatus, by reason of the quickness with which it reaches the fire and its ability to "get there" ready for instant use, regardless of weather or road conditions.

The firm of James Boyd and Bro., 23rd and Wharton, Philadelphia, have for a number of years manufactured a thoroughly efficient and durable line of horse-drawn fire apparatus. They have recently turned their attention to the motor equipment and have placed on the market an automobile chemical engine and hose wagon which possesses the features of durability and careful construction which characterized their horse-drawn apparatus.

The accompanying photograph shows their "Type B-701" equipment. The long wheel base (123-inch) with the heavy substantial chassis construction may be noted from the photograph. Extra large wheels (36x5 and 36x6) are also features which contribute to the lessening of vibration due to uneven road surfaces and therefore to the added life of the equipment.

The transmission is of the sliding gear power. The transmission is of the sliding gear selective type; three speeds forward and reverse. A double chain drive is provided, giving a maximum of power with less wear in the parts due to the sudden starting and stopping necessary in fire service. The machine will attain a speed of 40 to 50 miles per hour.

The other equipment includes the following: Two 30-gallon copper tanks with 200

feet of ¾-inch chemical hose and shut-off nozzle attached; two polished brass acid receptacle holders; one 20-foot extension ladder; one door opener; one crowbar; one axe; two fire department lanterns; one 13-inch engine bell; two 10-inch acetylene headlights; body has capacity for 1,200 feet of 2½-inch rubber lined cotton fire hose.

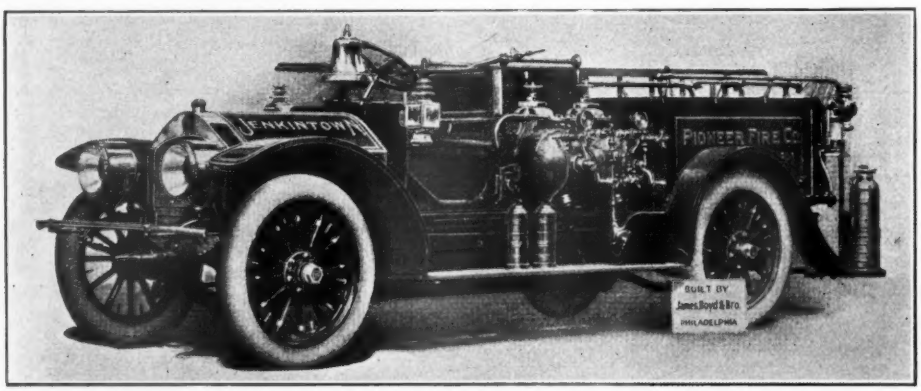
The Cement Industry in 1910.

The statistics of cement production in 1910, as reported by Ernest F. Burchard, of the United States Geological Survey, indicate that the cement industry ranks within the first eight extractive industries in the United States, the value of the cement produced being exceeded only by the value of th coal, pig iron, petroleum and gas, clay products, copper, gold and stone.

On the first of January, 1911, according to responses to telegraphic requests sent by the Survey to the larger cement companies, it was apparent that the Portland cement industry had made a new high record in 1910, and it was then estimated by Mr. Burchard that the production for the year might reach 75,000,000 barrels. Few other estimates ventured beyond this limit, and that it has been exceeded by more than half a million barrels, as is shown by the following statistics, will doubtless prove surprising to nearly every one closely in touch with the cement industry.

The total quantity of Portland, natural, and puzzolan cements produced in the United States during 1910 was 76,934,675 barrels, valued at $68,052,771. Compared with 1909, when the production was 66,689,715 barrels, valued at $53,610,563, the year 1910 showed an increase of 10,244,960 barrels, or 15.3 per cent., in quantity, and of $14,442,208, or 26.9 per cent., in value. The increase in quantity is one of the largest ever recorded, and the fact that the increase in value was proportionately higher indicates that trade conditions were slightly more satisfactory than during 1909.

The total production of Portland cement in the United States in 1910, as reported to the Geological Survey, was 75,699,485 barrels, valued at $67,506,479. This quantity, reduced to tons, is equivalent to 12,841,430 long tons, valued at $5.26 a ton. Compared with the output of pig iron for 1910, which was 27,298,545 long tons, having an estimated value of $419,851,622, or $15.38 a ton, the production of Portland cement approximates 47 per cent. of the quantity of pig iron and 16 per cent. of its value. In 1909 the production of Portland cement was 64,991,431 barrels, valued at $52,858,354; the output for 1910 therefore represents an increase in quantity of 10,708,054 barrels, or 16.5 per cent., and in value of $14,648,125, or 27.7 per cent. The average price per barrel in 1910, according to the figures reported to the Survey, was a trifle less than 89.2 cents. This represents the value of the cement in bulk at the mills, including the labor cost of packing, but not the value of the sacks or barrels. This average price is 16.5 cents higher than the average price received for cement in the Lehigh district, 14.2 cents higher than that in the eastern states, 1.8 cents lower than that in the central states, 13.8 cents lower than that in the western states, 4.8 cents lower than that in the south, and 48.8 cents lower than that on the Pacific coast. In the average price for the country is included the value of nearly 75,000 barrels of white Portland cement, which sold for an average of $2.86 a barrel.



BOYD MOTOR FIRE APPARATUS.

Publications Received.

Municipal Franchises. A description of the terms and conditions upon which private corporations enjoy special privileges in the

streets of American cities. By Delos F. Wilcox, Ph. D. In two volumes, $5.00 each. Engineering News, Book Dept., New York.

Flies and Mosquitoes as Carriers of Disease, by Wm. Paul Gerhard, C. E. Twenty-five cents. Published by author, 39 Strong Place, Brooklyn, N. Y.

Pittsburg Main Thoroughfares and the Downtown District. A report prepared under the direction of the committee on city planning. By Frederick Law Olmstead.

Second Annual Report of the Association for Standardizing Paving Specifications. Meeting held in New York January 10 to 14, 1911. Five dollars. John B. Hittell, secretary, City Hall, Chicago, Ill.

Eighth Annual Report of the Superintendent of the Perth Amboy (N. J.) City Water Works, for 1910. A. H. Crowell, superintendent.

Forty-fifth Annual Report of the Water Commissioners of Newburgh, N. Y., for 1910. Curtis Stanton, superintendent.

Report of the Superintendent of Coast and Geodetic Survey. Showing the progress of the work from July 1, 1909, to June 30, 1910. Department of Commerce and Labor. O. H. Tittman, superintendent.

Seventh Annual Report of the Water Board of the City of Auburn, N. Y., for 1910. J. Walter Ackerman, superintendent.

Fourteenth Annual Report of the Water Commissioners of the Town of Winchendon, Mass., for 1910. William F. Clark, superintendent.

Forty-first Annual Report of the Chief Engineer of the Water Department of Wilmington, Del., for 1910. John A. Kienle, chief engineer.

Electricity in the Development of the South. An address giving observations on the importance of federal incorporation for small companies engaged in interstate commerce. By George Westinghouse, Pittsburg, Pa.

Inheritance Tax. A bulletin of the extension division of the University of Wisconsin. Five cents. Published by the University, Madison, Wis.

The Man in the Pigeonhole. A satire on slavery to party lines in municipal elections. By John McAuly Palmer. National Municipal League, 703 North American Bldg., Philadelphia.

The Relation of Civil Service Reform to Municipal Reform. By Hon. Carl Schurz, New York. National Municipal League, Philadelphia, Pa.

Legal Liability as Trustees of City Officials and Employes, Under the Charter of Greater New York. Five cents. By William J. Curtis, Bureau of Municipal Research, 261 Broadway, New York City.

The New Era in Education. A study in the psychology of correspondence methods and instruction. By Rev. Joseph H. Odell, D. D. International Correspondence Schools, Scranton, Pa.

Fifty-third Annual Report of the Louisville Water Company, Louisville, Ky., for 1910. Theodore A. Leisen, superintendent.

Steam Power Plant Engineering. By G. F. Gebhardt. Third edition, revised and enlarged. Six dollars. John Wiley & Sons, New York City.

Sewerage, the Design, Construction and Maintenance of Sewerage Systems. By A. Prescott Folwell. Sixth edition, revised and enlarged. Three dollars. John Wiley & Sons, New York City.

Twenty-fifth Annual Report of the State Board of Health of Ohio, for 1909. C. O. Probst, M. D., secretary.

Good Engineering Literature. What to read and how to write with suggestive information on allied topics. By Harwood Frost. One dollar. Chicago Book Company, 226 South LaSalle St., Chicago, Ill.

Preliminary Report on Storage Reservoirs at the Headwaters of the Wisconsin River and their Relation to Stream Flow. By C. B. Stewart, conculting engineer, Madison, Wis.

A Study of the Water Supplies of the Isthmus of Panama. By John R. Downes, physiologist to the Isthmian Canal Commission, Mount Hope, C. Z.

Trade Publications.

Byerley & Sons, Cleveland, Ohio, manufacturers of Byerlyte Asphalt, have just issued two very attractive booklets dealing with the application of Byerlyte in waterproofing and paving.

The July Bulletin of the Universal Portland Cement Co., Chicago, Ill., contains a number of interesting photographs and descriptive matter concerning cement power house, coal bunkers, bridges, buildings, etc. Some country roads in Ohio which have been constructed of concrete are shown and descriptions of them are given.

The Chicago Portland Cement Co., 30 North LaSalle street, Chicago, have issued the first number of the "Cement Dealer," a publication devoted to establishing and maintaining a thorough understanding and a friendly attitude between the manufacturer and the dealer in cement. It will be published periodically and will contain information of interest and value to the cement dealer.

The Ansonia Brass and Copper Co., 99 John street, New York, have a booklet descriptive of "Tobin Bronze." The metal is used for bare and insulated copper wires and cables for trolley roads, electric lighting stations, power transmission lines, etc. Various tests of the material are noted together with instructions for ordering and manipulating.

The Delta Star Electric Company, 617-631 West Jackson boulevard, Chicago, have issued a sectional catalogue of transformers, fuses, and Pittsburg Automatic Mazda Street Series Lighting System.

The July issue of "Paving and Roads," the publication of the Texas Company, 17

Battery Place, New York, contains the following articles: Sheet asphalt without binder; asphalts, characteristic tests, by H. Tipper; new method of macadam road construction; Wellington street, Toronto, Canada; cost tables for road oiling.

The L. M. Booth Company, 136 Liberty street, New York, have a very attractive illustrated booklet describing the Booth Softener. Installations of the softener are shown together with a number of sectional photographs which illustrate the working principles of the apparatus. The details of operation are clearly shown and are further explained by an exceptionally clear description.

The McGuire Incinerator is a new garbage destructor, testimonials regarding the operation of which in Hobart and Tulsa, Okla., and Marlin, Tex., are sent out by W. H. McGuire, Hobart, Okla., the inventor.

Trade Notes.

ASPHALT.

Oklahoma City, Okla.—Special.—The secretary of state has issued a charter to the Oklahoma Asphalt and Refining Co., of Ardmore, Okla. The capital is $50,000 and the incorporators are J. T. Paschal, T. W. Carbutt and C. G. Spindler, all of Ardmore, Okla. This company will engage in the paving business. It controls large bodies of the native asphalt which is found in extensive quantities at Ardmore.

BRICK.

Baker, Oregon.—Special.—There has been discovered near the city and adjacent to a railroad, a very large body of fire, tile and pottery clays. Owing to the scarcity of these clays in the Pacific Northwest and the superior quality, the industry is assured of a great future. The Eureka Fire Clay, Brick and Tile Company, a corporation of Oregon, with headquarters in Baker, was recently organized for the purpose of manufacturing fire brick, tile and pottery of these clays and will erect a plant for that purpose in the near future. J. I. Wade is manager.

MACHINERY.

Columbus.—Special.—Frank T. Packard, architect, will receive bids at 10 a. m., August 12, for furnishing materials and installing feed wires and lights at the Ohio State Sanatorium, near Mount Vernon.

Pittsburg, Pa.—Joseph G. Armstrong, director of public service, will receive bids at 4 p. m., August 10, for furnishing coal and ash handling equipment at the Aspinwall pumping station; and for two water tube boilers, two mechanical stokers, flue and appurtenances at the Ross pumping station.

Austin, Tex.—The contract for constructing a dam and hydraulic plant to cost about $1,000,000 has been awarded to William D. Johnson, Hartford, Conn., subject to ratification by a referendum vote.

SEWERS.

Washington, D. C.—Consul-General Sammons, of Yokohama, Japan, reports that the authorities of Tokio have decided to install a complete sewerage system to cost between $17,000,000 and $20,000,000. Holders of American patents on sewer pipe should have the same registered in Japan. Address inquiries to Bureau of Manufacturers, No. 6934.

WATER.

Willow Okla.—The secretary of state has issued a charter to the Willow Water Works Co. The capital is $5,000 and the incorporators are W. O. Dodson, C. C. Holden, H. C. Webb, L. G. Cousins, all of Willow, and Zack T. Pryse, of Mangum, Okla.

CEMENT.

Neligh, Neb.—Bids will be received August 5 for furnishing cement for city use during the ensuing year. O. S. Hauser, city clerk.

Patents on Apparatus and Tools for Cement Workers.

867,819. Cement worker's tool. Frederick W. Grundmann, St. Louis, Mo.

868,238. Tamping bar. Ernest W. Wheeler, Bay City, Mich.

889,240. Protective setting for metallic bodies in concrete. Roman T. Kanski, New York, N. Y.

897,771. Tamping machine. Paul Olson, Stoughton, Wis.

899,185. Socket for use in concrete work. Elmer A. Purdy, Amboy, Ill.

923,188. Hanger socket for reinforced concrete. Frank N. Kneas, Norristown, Pa.

923,834. Cement worker's tool. John T. Harrop, Garfield, N. J.

926,886. Cement bucket. Willard D. Lockwood, Schenectady, N. Y.

930,374. Cement worker's tool. John T. Harrop, Garfield, N. J.

939,071. Apparatus and process of laying cement sidewalks or similar structures. Alexander D. Ney, Aurora, Ill.

840,601. Apparatus for laying concrete sidewalks, curbs, etc. Ernest L. Ransome, New York, N. Y.

943,327. Process of treating Portland cement surfaces and product. Maximilian Toch, New York, N. Y.

945,863. Concreter's bolt. Benjamin H. Paugh, Parsons, W. Va.

946,160. Form for laying artificial stone walks. Selvin C. Smith, Waverly, N. Y.

947,469. Device for roding off cement and concrete surfaces. James R. Gorden, Portland, Ore.

985,074. Tool for cement work. Ralph L. Sohn, Arrowsmith, Ill.

985,086. Adjustable clamp, employed in structural concrete construction. Paul Wilkes, Cleveland, O.

988,457. Sidewalk tool. Winfield S. Glasscock, Neodesha, Kas.

Patents Concerning Waterproofing and Solidifying Concrete.

869,280. Means for Frost-Proofing Concrete Walls. John H. Walzl, Baltimore, Md.

872,390. Lime Hydrating Machine. John H. Van Glahn, Toledo, O.

883,683. Waterproof Portland Cement Mortar and Process of Making the Same. Richard H. Gaines, New York, N. Y.

918,388. Process of Solidifying Mortar and Concrete Formations. Robert C. Stubbs, Dallas, Texas.

929,152. Method of Making Cement, Mortar and Concrete Water Tight. Paul Meeke, Stettin, Germany.

934,061. Waterproof Cement Block. John A. Fincke, New York, N. Y.

939,072. Rock-Like Substance. Alex. D. Ney, Aurora, Ill.

954,814. Waterproof Concrete Construction. Felix P. Lawrence, St. Louis, Mo.

968,591. Process of Treating Molded (Concrete) Articles. Walter M. Newton, Wyoming, Del.

976,520. Process of Making Water-proof Portland Cement and Product. Maximilian Toch, New York, N. Y.

985,709. Method of Waterproofing Cement Blocks. David F. Shope, St. Paul, Minn.

IMPROVEMENT AND CONTRACTING NEWS

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ROADS AND PAVEMENTS.

BIDS REQUESTED.

Jacksonville, Fla.—August 8, 3 p. m. Grading, curbing, laying sidewalks, etc., in various parts of the city. Certified check, $500. Phillip Prioleau, city engineer; Henry Gailland, chairman committee on public works.

Americus, Ga.—Paving the principal streets, about 50,000 sq. yds. T. N. Hawkes, city clerk.

Atlanta, Ga.—August 4, 12 m. Constructing tile walks and cement steps for ten new schools. Wm. M. Slaton, superintendent of schools.

Atlanta, Ga.—August 4, 3 p. m. Altering reinforced concrete tunnel to widen West Mitchell street. R. M. Clayton, chief of construction.

Brazil, Ind.—August 8, 11:30 a. m. Constructing gravel roads in Cass and Brazil townships. E. A. Staggs, auditor.

Brookville, Ind.—August 10, 1 p. m. Constructing certain highways. Chas. A. Miller, auditor.

Brownstown, Ind.—August 7, 1:30 p. m. Constructing two roads in Carr township. H. W. Wacher, auditor.

Corydon, Ind.—August 9, 2 p. m. Constructing gravel or macadamized road in two townships. William Taylor, auditor.

Decatur, Ind.—August 7, 10 a. m. Constructing macadam roads in Washington and Kirkland townships. H. F. Michaud, auditor.

Fowler, Ind.—Aug. 7, 1 p. m. Constructing two free stone roads in Hickory Grove township Lemuel Shipman, auditor.

Frankfort, Ind.—August 12, 2 p. m. Constructing 14,460 feet of gravel road. Chas. T. Cromwell, auditor.

Greensburg, Ind.—Aug. 7, 1 p. m. Constructing macadamized road in Washington township. Frank E. Ryan, auditor.

Lafayette, Ind.—August 9. Constructing gravel roads estimated as follows: Miller road, $3,635; Kolb road, $7,474; Taylor road, $2,142; Magee road, $5,235; Jackson road, $8,628; Stewart road $4975, also a number of small concrete arches and 2,000 feet of 5-inch drain tile.

Liberty, Ind.—August 7, 2 p. m. Constructing two gravel roads in Harrison township. Clinton Gardener, auditor.

Logansport, Ind.—Aug. 8, 10 a. m. Constructing various gravel and macadam roads in Cass county. J. E. Wallace, auditor.

Logansport, Ind.—August 9, 1 p. m. Constructing two macadamized roads in Noble township. J. E. Wallace, auditor.

Martinsville, Ind.—Aug. 8, 2 p. m. Constructing macadamized road in Jackson township. J. S. Whitaker, auditor.

Newport, Ind.—August 7, 10 a. m. Constructing gravel roads in Clinton township. H. C. Payne, auditor.

Noblesville, Ind.—August 9, 2 p. m. Constructing nine gravel roads. George Griffin, auditor.

Portland, Ind.—August 7, 10 a. m. Constructing highway in Wabash township. W. Lea Smith, auditor.

Salem, Ind.—August 7, 1:30 p. m. Constructing gravel road in Franklin township. F. S. Munkelt, auditor.

Spencer, Ind.—Aug. 8, 1 p. m. Constructing macadamized road in Jackson and Jennings townships. E. W. Edwards, auditor.

Versailles, Ind.—Aug. 7, 1 p. m. Constructing macadamized road in Laughery township. Nicholas Volz, auditor.

Wabash, Ind.—August 8, 1:30 p. m. Constructing gravel roads. J. P. Noftzger, auditor.

Washington, Ind.—Aug. 7, 2 p. m. Constructing gravel road in Washington township. Thos. Nugent, auditor.

Winamac, Ind.—August 8, 12 m. Constructing road in Pulaski county. W. E. Muchenburg, auditor.

Winchester, Ind.—August 4, 10 a. m. Constructing highways in six townships, eleven roads in all. Henry S. Wood, auditor.

New Ulm, Minn.—August 5, 1 p. m. Constructing cement sidewalks and crossings. Certified check, $50. Ernst Wicherski, clerk board of public works.

St. Paul, Minn.—August 7, 2 p. m. Regulating, grading, graveling roads, sodding, etc., around cottages of the Home School for Girls, Sauk Center, Minn. Morell & Nichols, landscape architects, Minneapolis, Minn.

St. Peter, Minn.—August 14, 8 p. m. Grading and graveling several streets.

Omaha, Neb.—August 5, 12 m. Furnishing culvert pipe for one year. Certified check, $50. D. M. Haverly, county clerk.

Bridgeport, N. J.—Aug. 9, 11 a. m. Improving 7.694 miles. Certified check, $1,000. Benjamin Erickson, chairman public road committee.

Newark, N. J.—August 8, 2 p. m. Grading, laying walks, etc., in the grounds of Montclair State Normal. Certified check, 10 per cent. William G. Schauffler, president state board of education.

Woodstown, N. J.—July 31, 1 p. m. Constructing asphalt-concrete road on East and West avenues. Certified check, $1,000. E. S. Fogg, mayor.

Ashland, O.—Aug. 2, 12 m. Improving about 3¾ miles of road with crushed limestone and tar or asphalt binder. Certified check, $200. Lotta Westover, clerk county commissioners.

Ashland, O.—August 7. Paving Sandusky street. Certified check, $200. Edward Koehl, city clerk.

Batavia, O.—August 8, 12 m. Grading and macadamizing 1.12 miles of road, $6,613.26; also 2.09 miles, $12,443. Certified check, $300. County commissioners.

Bowerston, O.—Aug. 5, 12 m. Paving Maine, State and Garfield streets with brick. Certified check, $500. W. F. Utterback, clerk.

Cambridge, O.—August 4, 10 a. m. Grading and paving with brick one mile of road, $13,386.34. Certified check, $300. County commissioners.

Canton, O.—August 4, 12 m. Grading and paving with brick 2.16 miles of road, $39,132.79. Certified check, $300. County commissioners.

Chillicothe, O.—August 1, 12 m. Paving and parking Main and High streets.

Cincinnati, O.—Aug. 14, 12 m. Grading, planting, sodding, cement and sewer work,

etc., and parking of the lot surrounding the Winton Place school. Guaranty, 30 per cent. C. W. Handman, business manager board education.

Columbus, O.—August 9, 2 p. m. Constructing various roads in Franklin county. Certified checks, $200 to $1,000. John Scott, clerk board of county commissioners.

Lisbon, O.—August 1, 1 p. m. Improving Carpenter's Run road. President county commissioners.

Marietta, O.—August 2, 12 m. Grading and paving with brick, 1.57 miles of road, $16,895.44. Certified check, $300. County commissioners.

McConnellsville, O.—August 5, 12 m. Grading and macadamizing two miles of road, $16,568.50. Certified check, $300. County commissioners.

Napoleon, O.—August 4, 10 a. m. Repairing Malinta-Hamler pike. Check, $500. C. C. Meekison, auditor.

New Philadelphia, O.—August 11, 12 m. Grading and paving with brick, 2.01 miles of road, $32,299.90. Certified check, $300. County engineers.

North Robinson, O.—August 1, 12 m. Constructing about 1,300 feet of pike. Jas. E. Morton, clerk of council.

Philadelphia, O.—August 7, 1 p. m. Constructing 1,900 feet of pike road on the Huff Run road. W. C. Shott, county auditor.

St. Clairsville, O.—August 10, 12 m. Grading and macadamizing .84 mile of road, $8,429.15; grading 2.26 miles, $7,400. Certified check, $300 with each bid. County commissioners.

Steubenville, O.—Aug. 10, 12 m. Grading, sewering and macadamizing the Wabash and Bloomfield free turnpike road, bids to be considered in four sections. Certified check, $500. County auditor.

Xenia, O.— Aug. 2, 10 a. m. Macadamizing about four-fifths of a mile. Dayton and Xenia road. Certified check, $100. Walter L. Dean, auditor.

Coraopolis, Pa.—August 7, 7:30 p. m. Grading, paving and curbing various streets, aggregating about 11,500 sq. yds. E. C. Harper, borough secretary.

Newcastle, Pa.—July 31, 8 p. m. Repaving Long avenue, North street and Washington street. Certified checks with each bid. H. M. Marquis, city clerk.

Pittsburg, Pa.—Aug. 8, 10 a. m. Road improvements: Five contracts aggregating about 14.3 miles. Certified check with each bid. R. J. Cunningham, county controller.

Scranton, Pa.—Aug. 3, 11 a. m. Constructing county road, 2.7 miles. Certified check, 5 per cent. E. A. Jones, county controller.

Washington, Pa.—August 7, 12 m. Resurfacing the following roads with tarvia, warrenite, amiesite or other asphaltum material: One mile in the borough of McDonald; certified check, $1,200. One and one-half miles in Washington borough; certified check, $500. John E. Moffitt, county auditor; Chaney & Armstrong, county engineers.

Marysville, Tenn.—August 7, 12 m. Grading and macadamizing 85 miles of roads in Blount county. Certified check, 5 per cent. T. E. Cooper, chairman Blount county pike commissioners.

Brownsville, Tex.—Aug. 15, 12 m. Constructing about 27,500 sq. yds. paving; brick, creosoted wood block, or bitulithic. L. B. Puente, city clerk.

Colfax, Wash.—August 7, 2 p. m. Improving 5,600 feet of the Colfax and Palouse City road. Certified check, 10 per cent. S. M. McCroskey, county auditor.

Everett, Wash.—August 14, 2 p. m. Constructing State aid road. Certified check, 10 per cent. P. T. Lee, clerk.

Seattle, Wash.—August 1, 10 a. m. Grading, curbing, etc., on various streets. Certified check, 5 per cent. C. B. Bagley, secretary board of public works.

Stevenson, Wash.—August 10. Constructing county road near Prindle. A. Flieschhauer.

Tacoma, Wash.—Brick paving, etc., at the Cuchman Indian School. H. H. Johnson, superintendent Cuchman School.

Superior, Wis.—August 2, 1 p. m. Repaving and recurbing North Fourteenth street. Bids will be received on bitulithic, macadam, creosote block, asphalt and brick. Board of public works.

CONTRACTS AWARDED.

Little Rock, Ark.—Paving Washington street, to I. T. Shelby, Little Rock, Ark. Paving of creosoted wood blocks.

Los Angeles, Cal.—Constructing 6.01 miles of Foothill boulevard and Sierra Madre avenue, to O. O. Farmer, $40,787.92.

Pomona, Cal.—Grading and oiling streets, to Thos. E. Crawford, Pomona, Cal.

San Francisco, Cal.—Yard work of the Denman Grammar School, to Henning & Burke, $30,888.

East St. Louis, Ill.—The following paving contracts have been awarded: Gray blvd., to the St. Clair Engineering & Construction Company, $15,318; Eighteenth st., to the same, $11,610; Twenty-seventh st., to P. C. Gaylord, $14,908.

Springfield, Ill.—Paving Pasfield street, to the Capital City Concrete Construction Company, Springfield, Ill.

Bloomington, Ind.—Constructing brick pavement on Third st., to Blair & Kerr, $41,265.

Crown Point, Ind.—Road construction as follows: Pearson road, to the Ahlborn Construction Company, $19,050; the Schaaf road, to Lavenge Bros., $42,689; the Black road, to Downey & Portz, $18,897.

Fowler, Ind.—Constructing gravel roads: Erskine road, $3,800, and Gerlach road, $4,500, to Girmut Co., Muncie, Ind.

Greencastle, Ind.—The following road contracts have been awarded: The Arnold road, to Hurst & Sweet, $4,858; the Matthews road, to McGuire & Son, $4,458; the Crawley road, to James Mahoney, $2,225; the W. J. Smith road, to James Mahoney, $7,389; the Wright road, to J. M. Lisby, $8,750.

Jacksonville, Ind.—Paving Meridian street, to Ewing Shields, Seymour, Ind., $18,275.57.

Martinsville, Ind.—Constructing macadam road in Adams township, to E. A. Bourn, $9,082.

Peru, Ind.—Constructing sidewalks for new court house, to C. H. McCormack & Co., Columbus, Ind., $9,495.

Vincennes, Ind.—Road construction as follows: Wampler road, to Jesse Williams, $7,890; the Shultz road, to Ed Bolmer, $7,992; the Pol road, to W. E. Ruble, $7,200; the Royse road, to A. E. Cain, $3,690; Ashley road, to H. F. Jones, $11,750; the Barnes road, to Sam Taylor, $2,400; the Stitz road, to James McAndrew, $6,900.

Winchester, Ind.—Constructing Greenville pike, to Rutel & Griffith, $30,037.

Ames, Ia.—Paving five blocks of Grand avenue with creosoted blocks, to Wm. Horrabin, Iowa City, Ia.

Des Moines, Ia.—Paving Thirty-sixth street, sheet asphalt, to Mayer Bros. Paving Co., Des Moines.

Iowa City, Ia.—Paving contracts have been awarded to William Harrabin and B. J. Lambert, both of Iowa City.

Maquoketa, Ia.—Paving nineteen blocks, sixteen of which are to be of brick, to M. Ford, of Cedar Rapids, Ia.

Red Oak, Ia.—Paving 20 blocks with brick on various streets, to Hamilton & Schwartz, Shenandoah, Ia.; 5 blocks, to Maken Bros., Plattsmouth, Neb.; curbing and guttering, to Horton Bros., Red Oak, Ia.

Ft. Scott, Kan.—Paving contracts have

been awarded to the Midland Construction Co. and to Thogmartin & Gardiner.

Manhattan, Kan.—Paving Pointz avenue, sub-let by C. W. Cook & Son, to the Kaw Paving Company.

Louisville, Ky.—Road contracts aggregating $32,000 have been awarded as follows: Edenside avenue, 1,400 ft., to the American Standard Asphalt Company; Harp avenue, 1,250 ft., to the Barber Asphalt Paving Company; Sill street, one block, to the Louisville Asphalt Co.

Boston, Mass.—Constructing 7,300 ft. of state highway, to Porchia Bros. Construction Company, $7,192.

Boston, Mass.—The following paving contracts have been awarded: Macadam roadway on Railroad street, to the West Roxbury Trap Rock Co., $4,162; brick pavement on Hancock street, to S. F. & A. P. Gore Corporation, $17,909; constructing curb and gutter on Milton avenue, to C. W. Dolloff Co., $1,634; gutters and sidewalks on Welds Hill, to James Doherty, $3,474.

Boston, Mass.—The following paving contracts have been awarded: Paving Fleet st. with granite block, to McGuire & Kiernan, $6,435; paving Roxburg st. with granite block, to Chas. S. Jacobs & Company, $2,240; constructing gutters in Hall st., to James Doherty, $1,544; paving North st. with granite block, to John F. O'Connell, $12,365.

Holyoke, Mass.—Paving Railroad, Essex and Jackson sts., with vitrified brick, to the Shawmut Brick Works, 141 Milk st., Boston, Mass.

Duluth, Minn.—Improving West End streets, to Hugo Steele, $41,141.

Hibbing, Minn.—Constructing the Iron Junction road, to Chris Daley, $4,180.

St. Paul, Minn.—Grading Grantham street, to Keough Bros., $2,592.

St. Joseph, Mo.—Paving contracts to Young Bros. Construction Co., and Land Bros.

Hastings, Neb.—Constructing Seventh st. paving, to M. Ford, Omaha, Neb.

Dunkirk, N. Y.—Paving contracts have been awarded to J. & M. Doyle and John McCormick & Son, both of Erie, Pa.

Little Falls, N. Y.—Paving Albany and Second streets, to the Warren Bros. Co., of Boston, Mass., $27,081.

Rochester, N. Y.—The following paving contracts have been awarded: Park avenue, asphalt pavement, to Whitmore, Rauber and Dicimus, $26,120; Gardiner avenue, asphalt pavement, to the Rochester Vulcanite Pavement Co., $15,613; Copeland street, brick pavement, to Clarence Aikenhead, $6,033; Pinnacle road, brick pavement, to F. G. Brotsth, $7858; Magee avenue, cement walks, to W. A. Macgrander, $893; Mohawk street, grading and constructing sidewalks, to J. Friedrich Co., $619.

Seneca Falls, N. Y.—Constructing West Falls st. pavement, to the Kennedy Construction Company, Albany, N. Y., $12.573.

Utica, N. Y.—Repaving Oneida street with bitulithic, to Warren Bros. Co., $11,820.

Athens, O.—The following paving contracts have been awarded: Elliott street and West State street, to Mill & Coss, $8,000; May avenue, to W. F. Bower, $5,-764; West State street, second section, to W. R. Wilson, $2,173.

Canton, O.—Paving Logan avenue and Shorb street, to Logan B. Burg, $11520 and $19,841, respectively; Paving Virginia avenue, to Press Campbell, $15,429; paving East Eighth street, to Turnbull & Sons, $26,574; paving Block and Arch street, to Peter Christensen, $3,084.

Cincinnati, O.—Road improvement, as follows: Sharon avenue, to J. P. Hunley, $10,-349; Springfield road, to H. E. Steele, $11,-712; Indian Hill avenue, to F. E. Schroeder, $9,740.

Columbus, O.—The following paving contracts have been awarded: Sixteenth ave., to M. J. Burns, $8,787; Seventeenth ave., to George W. Patterson & Sons, $10,030; Eldridge ave., to S. T. Knight, $10,006; Donaldson st., to Geigle, Garnes & Co.; Harris st., to W. M. Graham, $5,108; Hildreth ave., to A. G. Pugh, $13,084; Hughes st., to same, $2,758; McCoy st., to Geigle, Garnes & Co., $3,084.

Dayton, Ohio.—Street improvements, to Warren Bros. Paving Co., $2,176.20 for Liberty street, and $1,593.65 for DeKalb street.

East Liverpool, O.—Paving Fifth street, to George B. Patterson, $2,206.

Elyria, O.—Paving Broad st., to the Ohio Engineering Co., Elyria, O., $9,600.

Fremont, O.—Paving Lynn st., to Modern Construction Company, of Fremont, $9,922.

Geneva, O.—Paving Main street, to E. A. Freshwater & Son.

Hamilton, O.—Paving Charles street with sheet asphalt, to the Andrews Asphalt Paving Co.

Kent, O.—Paving Main street, to the Ohio Engineering Company, of Elyria, O., $28,480.

Lorain, O.—The following paving contracts have been awarded to the Ohio Engineering Company, of Elyria, O.: East Erie avenue, with brick, $31,720; Hamilton avenue, with brick, $7,345; alley west of Broadway, with brick, $4,151.

Mansfield, O.—Paving South street, West Liberty street and Mansfield road, to Her-

Marion, O.—The following paving contracts have been awarded: Marion Prospect road, to J. B. Gillespie, $6,162; constructing Tarvia road, to the Continental Bitumen Co., of Waldo, O., $5,345; resurfacing Marion Upper Sandusky road, $4.-052, tar work on same to the Continental Bitumen Company, $3,424.

Middletown, O.—Constructing asphalt pavement on Baltimore street, to the Andrews Asphalt Paving Co., of Hamilton, O., about $28,000.

Mt. Gilead, O.—Stone curbing, to Raymond & Caldwell, $2.450.50.

New Boston, O.—Grading the Harrisonville pike, to Asa Canter.

New Lexington, O.—Paving two sections of Main street, to George J. Bock & Son, of Coshocton, O., $12,500.

Pomeroy, O.—Paving Front street, to Geo. Bauer, Pomeroy; paving Kerrs Run, to J. E. Lindsey, of Middleport, Ohio.

Salem, O.—Paving ½ mile of road, to Morris & Morgan, Girard, O., $6,600.

Springfield, O.—Constructing macadamized road on Hillside avenue, to W. F. Payne, $3,482.

Toledo, O.—The following sidewalk contracts have been let: The Eddis Stone Co., $20,858; James H. Horan, $11,768; W. W. Hummell, $10,807; H. W. Wells, $5,636; paving Kelsey avenue, to John McMahon, $2,031.

Youngstown, O.—Grading Erie street, to Ed Kane, $3,485; paving Cleveland street, to Miller Bros., $9,811.

Youngstown, O.—The following road contracts have been awarded: Poland-New Middletown road, two miles, to Galdini and Mage; Poland-Center road, two miles, to Chambers and Halley; Lowellville and Hillsdale road, to J. W. Gay & Son. All roads to be macadamized.

Youngstown, O.—Paving Myrtle ave., to Kennedy Bros., $39.865.

Oklahoma City, Okla.—Paving Olie street with asphalt, to Cleveland Trinidad Paving Company, $28,278; Harvey avenue, to the Weston Paving Company, $29,322.

Portland, Ore.—Paving Milwaukie street with Hassam pavement, to the Consolidated Contract Company, $128,319.

Butler, Pa.—Paving American avenue with Butler and DuBois block, to Tony Morelli.

Erie, Pa.—Paving as follows: Fifth

street, to Mayer Bros, for Bermuda asphalt; Cascade street, to McCormick & Son; Liberty street, to Mayer Bros.

Greensburgh, Pa.—Road construction as follows: To McCardy Bros. & Co., Braddock, $71,248; to B. H. Cunningham & Son, Turtle Creek, $45,217; to P. J. Keck, Homestead, $73,762.

Harrisburg, Pa.—Paving four streets, to the Barbar Asphalt Paving Co.; paving eleven streets, to The Central Construction & Supply Co.

Indiana, Pa.—Paving Seventh street, to M. Bennett & Son.

Mt. Pleasant, Pa.—Constructing roads, to McCrady Bros. & Co., Braddock,, $71,248; H. B. Cunningham & Son, Turtle Creek, $45,217, and P. J. Keck, Homestead, $73,762.

Newcastle, Pa.—The following paving contracts have been awarded: N. Mercer st., to Kimbrough & Elder, $5,243; Winter ave., to the Newcastle Contracting Company, $6,765.

Philadelphia, Pa.—Repairs, resurfacing and paving, to the Barber Asphalt Paving Company, about $500,000; constructing vitrified brick and granite block, to the Mack Paving & Construction Company.

Philadelphia, Pa.—Resurfacing York road, about two miles, with Filbertine, to the Filbert Paving Co., $30,000.

Pittsburg, Pa.—The following paving contracts have been awarded: Cement walk in Riverview Park, to Pittsburg Sanitary Flooring Co., $2,130; sidewalk in Arsenal Park, to M. Welsh & Co., $2,063.

Pittsburg, Pa.—Constructing Guyasuta road, to Dallas and Nargulli, $7,712.

Reading, Pa.—Macadamizing nine blocks of street, to John Weigner, $10,750.

St. Clair, Pa.—Paving Clover street, to A. G. Neeld, Jr., $7,488.

Scranton, Pa.—The following paving contracts have been awarded: Pine street and Washington street with stone block, to Blewitt Paving & Construction Co.; Wyoming avenue and Green Ridge, to the MacDonald Construction Co.; Sunset avenue, Vermont street and Kressler Court, to same.

Sharon, Pa.—Paving West State street with Tarvia with slag base, to William McIntyre & Sons.

Union City, Pa.—Building concrete culvert and two breakwaters, to Thomas McDannell.

Washington, Pa.—Constructing 22 miles of brick-paved highway, aggregating $348,259.95, to F. J. Erbeck, of Homestead; Collins-Gordon Co., of Pittsburg; Samuel Gamble, of Carnegie; Hastings & Piper, of Charleroi; Reed & Liggett, of Washington, and William Pickett & Co., of Washington.

Memphis, Tenn.—Paving Union ave., to R. C. Huston, $17,200.

Dallas, Tex.—Paving Cole avenue, to J. A. Gregory, $32,260.

Colfax, Wash.—Constructing bitulithic pavement, to the Warren Construction Company, $76,111.

North Yakima, Wash.—Constructing walks, curbs, etc., to Wilson & Hardy, $24,146.

Seattle, Wash.—Constructing sidewalks on Thirty-second avenue, to Allain & Hull, Seattle, $4,382.25; sidewalks on Weller street, to Smith Contracting Co., Seattle, $4,458.40, and paving Twenty-first avenue, North, to Barber Asphalt Co., $122,835.85.

Seattle, Wash.—Paving, grading, etc., to Barber Asphalt Co., $19,400; to Andrew Peterson & Co., $37,589; constructing concrete walks, to DeFlong & Co., $1,135; grading and curbing, to Macquaid & Moore; constructing walks, to Krogh & Jesson, $8,327.

Seattle, Wash.—The following street improvement contracts have been awarded: Alley in Block 2, to MacQuaid & Moore, 472 Arcade building, $730; sidewalk on East Fiftieth street, to Krogh & Jessen, 1418 Twenty-fourth avenue, $8,327.

Seattle, Wash.—The following paving contracts have been awarded: Belvidere avenue, to L. C. Lane, Hinckley block, Seattle, $52,586; grading alley in block 2, to Macquait and Moore, 472 Arcade building, Seattle, Wash., $730; constructing concrete walk on Market street, to the Smith Constructing Co., Empire building, Seattle, $3,591.

Spokane, Wash.—Grading etc., to Naylor & Norlin Co., two contracts, $6889 and $19,979, respectively; Massie Bros & Long, two contracts, $9,476 and $5,177, respectively; to J. C. Kennedy, $1,950; and sidewalk, to Abbott & Joslin, $634.

Spokane, Wash.—The following grading and sidewalk contracts have been awarded: To Massie & Lang, 612 Buckeye ave., $16,288; Euclid ave., $4,035; Lidgerwood st., $20,949; Jefferson st., $8,039; Mission ave., $26,630. To J. P. Kennedy, 1418 Riverside ave., Twenty-third ave., $7,228. To C. N. Payne, 2724 Mission ave., Gordon ave., $10,130; Crown ave, $6,720; Pittsburg st., $4,445. To Abbott & Joslin, P. O. Box 513, structing water works system as noted in Conklin st., $3,959; Wall st., $6,700. To Penn Paving & Construction Co., Rockwood blvd., $3,540; Arthur st., $12,000; Highland blvd., Rockwood blvd. and Garfield road, $51,000. Paving with Hassam concrete, to the Inland Empire Hassam Paving Company, 322 Lindell block, Washington st., $29,280. Paving with asphalt, to J. S. Hill, 601 Jamieson block, Howard st., $18,970.

Clarksburg, W. Va.—Paving the Northwestern turnpike, to Allen & Horner, Clarksburg, W. Va.

Wheeling, W. Va.—Paving Ellet street, to Pickett & Shannafelt.

Milwaukee, Wis.—Paving construction, to Badger Construction Co., of Milwaukee, and R. F. Conway Co., of Chicago.

Rhinelander, Wis.—Improving streets, to McGrath Construction Co., Green Bay, Wis., $13,625.

Vancouver, B. C.—Improving Twenty-sixth street with Tarvia, to Rector & Daly, $21,995; improving Harney street, to S. P. White, $6,991.

CONTEMPLATED WORK.

Los Angeles, Cal.—The board of public works has authorized the purchase of 11,000 barrels of crude oil for use on the roads.

Pasadena, Cal.—The city is contemplating the construction of oil macadam roadways on five streets to cost about $300,000.

St. Petersburg, Fla.—A $35,000 bond issue for the construction of brick paving has been voted.

Tampa, Fla.—The city is contemplating the paving of Zack street, to cost about $7,000.

Danville, Ill.—Ordinances passed for the construction of sidewalks on North, Chandler and Vermilion streets.

East Moline, Ill.—The city is contemplating the paving of State street with brick, to cost about $53,000.

Boston, Mass.—The city is contemplating the re-paving of Tremont st., to cost about $50,000.

Hibbing, Minn.—The city council has ordered the construction of cement sidewalks on several streets.

Litchfield, Minn.—Cement sidewalks have been ordered in on several streets. John Rodange, village recorder.

Lucerne, Minn.—The city council has authorized the construction of sewers.

Pipestone, Minn.—Cement sidewalks have been ordered in on several streets. S. W. Funk, city recorder.

St. Paul, Minn.—The city is contemplating the paving of Summitt ave., to cost about $80,000.

Belton, Mo.—A $10,000 bond issue for macadamizing of different streets has been voted.

St. Joseph, Mo.—The city council has passed an ordinance for paving in Seventeenth street with Bermudez asphalt macadam.

Buffalo, N. Y.—The city is contemplating the paving of Main street. Frances G. Ward, commissioner of public works.

Lancaster, N. Y.—The city is contemplating the paving of Central ave., to cost about $43,000.

Seneca Falls, N. Y.—An $81,000 bond issue for street improvements has been voted.

Charlotte, N. C.—Bonds have been voted for the construction of street improvements, water works and sewers.

Max, N. D.—Cement sidewalks have been ordered in on several streets. Theo. W. Kemps, village clerk.

Canton, O.—The paving of the Canton-New Berlin road, to cost about $38,000, is contemplated.

Cincinnati, O.—The city council has ordered the paving of Delaney street. Edwin Henderson, clerk.

Hamilton, O.—A survey for two miles of macadamized roads, to cost $14,000, has been completed. L. A. Dillon, county surveyor.

Mansfield, O.—The city council has authorized grading and laying sidewalks in Buckley and Western avenues. Director of public service.

Mineral City, O.—The county has ordered construction work on the Jefferson township and Newport pikes.

New Philadelphia, O.—Aug. 7, 1 p. m. Piking two roads. Certified check, $50. W. C. Shott, county auditor.

Youngstown, O.—The city council has ordered the grading of Essex, Burke and Garland streets, and the paving of Central avenue.

Beaver, Pa.—A $20,000 bond issue for street improvement has been voted.

Carnegie, Pa.—The council has voted to pave Highland avenue and Homestead with brick. H. R. Bigham, borough clerk.

Mt. Pleasant, Pa.—The town council has voted to grade, curb and pave North Shupe street. M. A. King, secretary of council.

Pittsburg, Pa.—The city has authorized the construction of a relief sewer in the Negley Run drainage basin; also sewers in Bates and Russell streets.

Reading, Pa.—The city has ordered paving in Court and Seward streets.

Sebring, O.—The city council has authorized the paving of Ohio avenue. Harry Jenkins, clerk.

Sharpsburg, Pa.—Grading Butler street has been authorized.

Milwaukee, Wis.—The constructing of a boulevard along the Janesville plank road is contemplated.

SEWERS.

BIDS REQUESTED.

Prescott, Ark.—August 9, 4 p. m. Furnishing materials for the construction of sanitary sewers, to cost about $40,000. J. W. Beebe, Poteau, Okla., engineer.

Washington, D. C.—The American consul general at Vancouver, B. C., reports that bids are wanted for sewer pipe, about ten miles. Bureau of Manufactures, No. 7010.

Americus, Ga.—August 1, 7 p. m. Constructing sewers and appurtenances, about 12 miles. T. N. Hawkes, city clerk.

Thomaston, Ga.—August 23, 2 p. m. Constructing sewer and water works. Certified check, 5 per cent. R. E. Rushin, city clerk.

Ligonier, Ind.—Aug. 10, 2 p. m. Constructing sewage plant and sewage purification plant, as noted in Bulletin of July 1. Ira F. Brant, secretary. F. S. Shaw, Reading, Pa., engineer.

Pella, Ia.—August 2. Constructing 15,000 feet of sewer. A. C. Kuypper, city clerk.

Frankfort, Ky.—August 1, 12 m. Constructing septic tank and filter bed at the Kentucky Houses of Reform, Greendale, Ky. Certified check, $500. Eli H. Brown, Jr., chairman of prison commissioners.

New Orleans, La.—September 11, 12 m. Sewers and drainage work. Geo. G. Earl, general superintendent; S. S. Shield, secretary.

Boston, Mass.—August 1, 12 m. Constructing sewerage works in Market street and in Perthshire road, Brighton.

Neligh, Neb.—Aug. 5, 1 p. m. Constructing sanitary sewers, to cost about $10,000. Certified check, $500. O. S. Hauser, city clerk.

West Orange, N. J.—August 1. Constructing sewers in Kirk street. Certified check, $100. Joseph McDonough, town clerk.

Cincinnati, O.—August 1, 12 m. Constructing main and lateral sewers, with appurtenances, in ravine between Reading road and Ridgeway avenue. Certified check. John J. Wenner, clerk director of public service.

Girard, O.—Constructing storm water sewer in Liberty street. Certified check, $500. James E. Stotler, village clerk.

Nottingham, O.—August 4, 12 m. Constructing sewers in Forest avenue, Sunset drive and Park road. Certified check, $100, with each bid. J. C. Steinicke, clerk.

Toledo, O.—August 3, 12 m. Constructing local sewer No. 1118. Certified check. Fred Shane, secretary director of public service.

Crafton, Pa.—August 1, 4 p. m. Constructing various sewers. Certified check, $250. McBride Surveying and Engineering Co., Ltd., Pittsburg, borough engineers.

Lebanon, Pa.—August 10, 5 p. m. Constructing 6,400 lineal feet of 30-inch outfall sewer and disposal plant. Certified check, 5 per cent. About 29,000 lineal feet of vitrified-pipe sewers, from 6-inch to 18-inch diameter; about 700 feet of 18-inch cast iron pipe, and 2,200 feet of 24-inch reinforced concrete pipe, with manholes, flush tanks and other appurtenances. Certified check, $2,500. E. R. Crowell, city engineer.

Nashville, Tenn.—August 10, 3 p. m. Building about seven miles of brick trunk sewers. Certified checks. Wm. W. Southgate, city engineer.

Huntington, W. Va.—Aug. 7, 1 p. m. Constructing vitrified tile sewers. John Coon, commissioner of streets. A. B. Manpin, city engineer.

CONTRACTS AWARDED.

Mobile, Ala.—Constructing wooden storm sewer, to C. A. Chamblin, $3,564.

Dixon, Cal.—Constructing sewer and disposal plant, to Brady & Fisher, San Francisco, $23,985.

Oakland, Cal.—The following sewer contracts have been awarded: District No. 1, to Chambers & Heafy, $79,132; District No. 2, to Contra Costa Construction Co., $77,-877; District No. 3, to C. B. Vincent, $102,-126; District No. 4, to C. B. Vincent, $110,-625.

San Francisco, Cal.—Constructing sewers in section G, of the north point main, to John Daniel.

San Francisco, Cal.—Constructing Section D-2, North Point main sewer, to Healy-Tibbits Construction Co.

Denver, Colo.—Constructing storm sewers, to the Gaffy & Keefe Construction Co., $8,-140; Denver-Pueblo Construction Co., $13,-181.04.

Michigan City, Ind.—Constructing sewer on Michigan street, to Peter Michaely-, Michigan City.

Valley Junction, Ia.—Constructing city sewers, to Geo. M. King Construction Co., Des Moines, Ia., $15,159.30; constructing outlet and disposal plant, to Geo. A. Mallory & Co., Kewanee, Ill., $12,329.

Waterloo, Ia.—Constructing 6,080 ft. of 10 to 30-inch sewer, to the Blackhawk Construction Co., Waterloo, Ia.

Waterloo, Ia.—The following sewer contracts have been awarded; $3,020 ft. sanitary sewer, to the Dearborn Jackson Construction Company, of Cedar Rapids, Ia., $1,685; 1,240 lineal ft. storm sewer, to M. A. Panery, of Harlan, Ia., $1,554.

Boston, Mass.—Constructing pipe sewers, to Timothy Coughlin, $526.

Bay City, Mich.—Constructing 30-inch concrete pipe, to P. Ryan & Son.

Detroit, Mich.—Constructing Fairview sewer, to John Gindel, 404 Buhl bldg., $32,700.

Duluth, Minn.—Constructing storm sewer in Forty-first avenue, to J. A. Johnson, $6,336.

Fairmont, Minn.—Constructing 12,000 ft. of sewers, to J. W. Turner Construction Company, Des Moines, Ia., $9,780.

St. Paul, Minn.—Sewer extension on Richmond street, to E. T. Webster, $928.

St. Joseph, Mo.—Sewer construction, to E. F. Mignery.

Whitefish, Mont.—Constructing sewers, to Sam Odergard, Kalispell, Mont., $13,500; septic tanks, to W. A. Powers, Kalispell, Mont.

Paterson, N. J.—Constructing Section A of the West Paterson and Totowa sewer, to McKiernan & Bergin, $28,304.75.

Buffalo, N. Y.—Constructing 12 to 36-inch tile sewer in Connelly street, Olympic, Warwick and Northumberland avenues, to W. C. Pulliton, $16,793.

Kent, O.—Constructing sewer in East Main street, to Norman & Son, Kent, O.

Lafayette, O.—Sewer construction, to Scanlon & Trainor, Huntington, W. Va.

Lancaster, O.—Constructing sewer in West Sixth avenue, to Clover & Sheets, $2,867.59.

Mansfield, O.—The following sewer contracts have been awarded: Storm water sewer on W. Third st., to Lyman Ostrander; sanitary sewer on Elmwood Drive, to George C. Long.

Niles, O.—Constructing sewer in Chester st., No. 1, to F. Manelli, Pittsburg, Pa.

Portsmouth, O.—Constructing sanitary sewers, to John A. Grimes, $541 and $726.

Springfield, O.—The following sewer contracts have been awarded: Cedar street, to Daniel Doyle, $5,591; Thompson avenue, to M. J. Cooney, $419; Water street, to same, $547; Innessallen avenue, to same, $468.

Toledo, O.—The following sewer contracts have been awarded: To A. Greybowski, $3,337 and $330; to H. G. Frobase, $896.

Chandler, Okla.—Constructing sewers, to Van Meter & Co., Oklahoma City, $16,600.

Shawnee, Okla.—Sewer construction, to the Western Paving Company, of Oklahoma City, Okla., $18,261.

Hillsboro, Ore.—The following sewer contracts have been awarded: Sanitary sewers, to Mason & Combs, Portland, Ore., $35,340; storm sewers, to the Kennedy Construction Company, $28,273.

Oregon City, Ore.—Constructing sewer, to Harry Jones, $7,200.

Connellsville, Pa.—The construction of a complete sewerage system and sewage disposal plant is contemplated. A. B. Hogg, engineer.

Eddystone, Pa.—Constructing sewers, to the Cantrell Construction Company, Philadelphia, Pa., $8,950.

Erie, Pa.—Constructing 9-inch sewer in Thirteenth street, to Edward Driscoll.

Newcastle, Pa.—The following sewer contracts have been awarded: Sanitary sewer on McCreary ave., to Kimbrough & Elder; sanitary sewer on S. Mill st., to Frank M. Mayberry & Son.

West Chester, Pa.—Constructing main outfall sewer, to the Corcoran Construction Company, West Chester, Pa., $11,000; constructing disposal plant, to the Farrell Company, West Chester, $46,000.

Wilkinsburg, Pa.—July 16, 4 p. m. Constructing 10 and 20-inch pipe sewers on Penn ave.; 8-inch sewer on Wright ave., to Frease & Sperling, engineers.

Madison, S. D.—Constructing sewer system, to L. M. Meeker and Arthur Dobson, Lincoln, Neb., about $30,000.

Nashville, Tenn.—Constructing sewer on the Jo Johnston ave. sewer, to F. C. Daniels.

Olympia, Wash.—Constructing trunk sewer, to James Mitchell, $4.339.

Seattle, Wash.—Constructing sewers, to Johnson & Co., $44,067.

Spokane, Wash.—Constructing various sewers, to P. L. Langen, $38,979, and to J. C. Broad, $4,165.

Seattle, Wash.—The following sewer contracts have been awarded to Krogh & Jessen, North Fifty-ninth street: Two sections, at $46,515 and $13,381.

South Bend, Wash.—Constructing trunk sewer, to the Jahn Contracting Company, Empire bldg., Seattle, Wash., $26,085.

Chippewa Falls, Wis.—Constructing sewers, to Frazer & Danforth, St. Paul, Minn., $5,201.

Janesville, Wis.—Constructing sewers in N. Main st., to Tibbey Bros., Dubuque, Ia., $11,925.

Superior, Wis.—Constructing sewer in Lamborn avenue, to John Anderson, $3,410.

Cranbrook, B. C.—Constructing a water supply system, to Galt Engineering Works, $100,000.

Winnipeg, Man.—Constructing sewers as follows: Trunk sewer and Mission street sewer, to Van Hornbeck Co., $63,403 and $26,731.53, respectively; Montcalm street sewer, to Hern & Knox, $1,953; various other sewers, to Felix Cottonier, aggregating $8,178.15.

CONTEMPLATED WORK.

Little Rock, Ark.—A committee has been appointed to make plans for the construction of storm sewers. Chas. E. Taylor, mayor.

Los Angeles, Cal.—The board of public works contemplates constructing sewers for Hollywood and the northwestern part of the city, to cost about $500,000.

Pacific Grove, Cal.—The construction of a $62,000 sewer system is contemplated. T. B. Hunter, Monterey, Cal., engineer.

San Francisco, Cal.—The board of public works has been authorized to construct sewers in Glen Park extension, $25,000, and North Point main sewer, $85,000, and various other sections. W. R. Hagerty, clerk board of supervisors.

Washington, D. C.—Consul-General Sammons, of Yokohama, Japan, reports that the authorities of Tokio have decided to install a complete sewerage system to cost between $17,000,000 and $20,000,000. Holders of American patents on sewer pipe should have the same registered in Japan. Address inquiries to Bureau of Manufacturers, No. 6934.

Bloomington, Ill.—Construction of the Clayton street sewer has been authorized.

Danville, Ill.—Ordinances passed for sanitary sewers in the alleys between Douglas avenue and Wayne street, and in the alley between Douglas and McReynolds avenues.

Rockford, Ill.—The city engineer has prepared plans for a sanitary sewer to cost about $36,700.

Columbus, Ind.—The city is contemplating the construction of a complete sewer system.

Cedar Rapids, Ia.—A $55,000 bond issue for sewer construction has been voted. L. J. Story, city clerk.

Logan, Ia.—The city is contemplating the construction of sewers to cost about $22,500. Bruce & Spandezen, Bee bldg., Omaha, Neb., engineers.

Lake Charles, La.—A sewerage system to cost $160,000 is contemplated.

St. Joseph, Mo.—Ordinances passed for construction of sewers for Chestnut, Atchison and Helena streets, and in McCool's addition.

Butte, Mont.—The city is contemplating the construction of sanitary sewers. Paul A. Gow, engineer.

Lincoln, Nebr.—The city is contemplating the construction of sewers to cost about $40,000.

Montclair, N. J.—The county engineer has been authorized to ask for bids for 500 ft. of storm sewers in Bloomfield avenue.

Paterson, N. J.—The board of public works has authorized the construction of six sections of the West Paterson and Totowa sewer.

Binghamton, N. Y.—The city council has ordered the construction of sewers in Pennsylvania and Vestal avenues.

Matteawan, N. Y.—A $60,000 bond issue for water works and sewer improvements has been voted.

Charlotte, N. C.—Bonds have been voted for the construction of sewers, water works and street improvements.

Akron, O.—The city council has authorized the construction of sewers in Jewett street. Dow W. Harter, clerk of council.

Cincinnati, O.—The city council has ordered the construction of 12-inch, 15-inch and 18-inch vitrified pipe sewers in Waverly avenue and Blaine road. Edwin Henderson, clerk.

Cleveland, O.—The city council has authorized construction work on the Ontario street and Warren road sewers. Director of public service.

Columbus, O.—The construction of a sewer known as the Milo main trunk sewer, to cost $50,000, is contemplated. Leroy H. Rose, acting clerk.

Hamilton, O.—The council has authorized sewer work in Ludlow, Sycamore and Seventh streets. Director of public service.

Lorain, O.—The council has authorized the construction of sewers. Director of public service.

Mansfield, O.—The city council has authorized the construction of various sewers. Director of public works.

Youngstown, O.—The city council has ordered the construction of a sewer in Bernard street.

Chickasha, Okla.—A $25,000 bond issue for the purpose of reclaiming 2,000 overflow land has been voted by the city.

Oklahoma City, Okla.—The commissioners have voted to establish four new sewer districts.

Oklahoma City, Okla.—The city commissioners are inspecting septic tanks and contact beds with a view to the installation of a sewage disposal system in Oklahoma City.

Shawnee, Okla.—The city is contemplating the construction of five miles of sewer, the contract for which will be let soon. Frank D. Brown, city engineer.

Eugene, Ore.—The city council has ordered the construction of sewers to cost $12,000.

Hood River, Ore.—The city is contemplating the construction of about 15,000 ft. of sanitary sewers.

Springfield, Ore.—The city council has ordered the construction of three main sewers, about $12,000.

Altoona, Pa.—The city will engage Hering & Fuller, of New York, to complete plans for construction of main sewers in the eastern district.

Canonsburg, Pa.—The town council has voted to construct certain sewers. W. C. Black, secretary of the council.

Grove City, Pa.—The council has voted to construct a sanitary sewer in Barmore avenue and Stewart street. L. L. McKay, borough clerk.

McKees Rocks, Pa.—The commissioners have authorized the construction of sewers.

Scranton, Pa.—The city is contemplating construction of sewers on various streets. P. C. Jordan, president of council.

Washington, Pa.—The town council has authorized the construction of 1,180 feet of sanitary sewer. J. F. Curran, president of council.

Wilkinsburg, Pa.—The borough council has authorized the construction of a sewer or culvert to inclose Nine Mile run. Borough engineers.

Dallas, Tex.—The city contemplates building sewers and water works.

Rocky Mount, Va.—The city has voted $50,000 for construction of water works, electric light plant and sewer system.

Shelton, Wash.—A $15,000 bond issue for sewer construction has been awarded.

Tacoma, Wash.—The city is contemplating the construction of sanitary sewers on S. Thirty-fourth and other streets to cost about $23,000. Owen Woods, commissioner of public works.

WATER WORKS.

BIDS REQUESTED.

Monte Vista, Colo.—August 15. Erecting steel water tank and tower at the Soldiers' and Sailors' Home. O. S. Storrs, president.

Thomaston, Ga.—August 23, 2 p. m. Constructing water works and sewers. Certified check, 5 per cent. R. E. Rushin, city clerk.

Cicero, Ill.—Laying water supply pipe, about $5,300. Chas. Stoeffel, clerk board of local improvements.

Brazil, Ind.—August 8, 11:30 a. m. Constructing complete water works and electric light plant. J. D. Walpole, recorder.

Alice, Minn.—August 2, 8 p. m. Constructing village well, water mains and steel water tank. A. E. Dyer, village engineer, Hibbing, Minn.; Oscar Wirstrand, village clerk.

Preston, Minn.—August 7, 8 p. m. Laying 2-inch water pipe. W. Kruppenbacher, village recorder.

Anselmo, Neb.—August 8, 8 p. m. Constructing a complete water-works system. Certified check 5 per cent. E. E. Philpott, village clerk.

Bottineau, N. D.—July 31, 8 p. m. Constructing a shallow well with wood, brick or concrete curbing. Certified check 5 per cent. D. R. Carlson, city auditor.

Athens, O.—August 10, 12 m. Furnishing air compressor, air receiver, reservoir and pipe connections for five air lift wells at the Athens State Hosiptal. Dr. O. O. Fordyce, secretary board of trustees; Osborn Engineering Co., engineers, 20 E. Broad st., Columbus, O.

Pittsburg, Pa.—August 4, 10 a. m. Furnishing coal and ash-handling apparatus for the Aspinwall pumping station. Bond, $9,000. Jos. G. Armstrong, director of public works.

Pittsburg, Pa.—August 4, 10 a. m. Furnishing two water tube boilers, two mechanical stokers, flue and appurtenances for Ross pumping station. Bond, $8,500. Jos. A. Armstrong, director of public works.

Ft. Worth, Tex.—Sept. 5. Constructing a dam containing about 300,000 cu. yds. of earthwork and 60,000 cu. yds. of masonry; also 6½ miles of concrete pipe. Board of engineers.

CONTRACTS AWARDED.

Russellville, Ala.—Constructing water works and light plant, to W. W. Moore, Birmingham, Ala.

Auburn, Ga.—A $20,000 bond issue for installation of water works and sewer systems has been voted. J. B. McCreary, Atlanta, Ga., engineer.

Gilmore City, Ia.—Constructing a water works plant, to C. W. Roland Co., Des Moines, Ia., $13,595.

Emporia, Kan.—Constructing water works system, to Builders Material Supply Company, Scarritt bldg., Kansas City, $9,097.

Boston, Mass.—The following water contracts have been awarded: Relaying pipe on Brighton street, to S. Bambia, $10,119; laying water main on Intervale street, to Hugh McNulty, $1,140; relaying water pipe on Church, to J. A. Costello & Co., $1,175; furnishing 1,500 concrete meter boxes, to Eagar & McNamee, at $4.10 each.

Ada, Minn.—Digging 10-inch artesian well, to Swenson Artesian Well Co., Minneapolis, Minn.

Ellsworth, Minn.—Constructing 50,000-gallon reservoir, to C. N. Gilhan, Luverne, Minn.

Eveleth, Minn.—Supplying 36 tons of 7-inch cast iron pipe and three valve boxes,, to Jas. B. Clow & Sons, Minneapolis, Minn.

Fairmont, Minn.—Constructing seventeen blocks of water mains, to the J. W. Turner Construction Company, Des Moines, Ia., $5,850.

Mankato, Minn.—Installing the East Mankato auxiliary water plant, including 50,000-gallon steel tank, 110-foot steel tower, pipe lines, pump house, pump and motor, to J. G. Robertson, St. Paul, $6,850.

Chadron, Neb.—Furnishing wood pipe for water works system, to the Portland Pipe Co., $17,000; constructing the dam and laying the pipe, to the Inter-Mountain Bridge and Construction Co., $8,232.

Crosswick, N. J.—Constructing water works for the Crosswick Water Company, to cost $13,500, to Thomas J. McGovern, of Trenton, N. J.

Buffalo, N. Y.—Constructing water works intake pier, to Chas. H. Everitt, 424 White building, Buffalo, $43,490.

New York, N. Y.—Constructing Hudson river division of Catskill equeduct, to T. A. Gillespie Co., Pittsburg, Pa., $1,649,020.

Tarboro, N. C.—Construction works improvements, to the Edwards Construction Company, of Tarboro, N. C.

Lucasville, O.—The village is contemplating the installation of a water works system. Address Alonzo Purdy, or W. E. Purdy.

Altus, Okla.—Drilling 2,500-foot well for artesian water supply, to Kerwin Drilling Co., Petrolia, Tex.

Dewey, Okla.—Constructing water works system, to F. R. Stone, $36,350.

Oklahoma City, Okla.—Constructing concrete dam at the water plant, to Reinhart & Donovan, Oklahoma City, Okla., $9,339.

Baker, Ore.—Constructing 8¾ miles of concrete pipe line, to the Idaho Glazed Cement Pipe Co., $90,000.

Toledo, Ore.—Constructing water system, 6 miles of pipe, to Jacobson-Bade Co., Portland, Ore., $20,000.

Bristol, Pa.—The borough council has authorized the purchase of the Bristol Water Co.'s plant, $112,640.

Falls Creek, Pa.—Constructing water works system, to Minns Bros., Du Bois.

Austin, Tex.—A contract has been let for the construction of a dam and hydraulic plant, to William D. Johnson, Hartford, Conn., $1,000,000, subject to ratification by a referendum vote.

Dallas, Tex.—Constructing three Woodbine wells, to Sharp & Co.; constructing two wells, to Fausett & Hall, of Corsicana, Tex.

Seattle, Wash.—Supplying lock bar pipe on Cedar river water supply system, to E. W. Cummings and C. H. Kiehl, at $172,817.

Seattle, Wash.—The following contracts for water construction have been awarded: Laying water mains on West Sixtieth street, to Church & Erickson, 126 Twentieth avenue, Seattle, Wash., $13,307; constructing penstock, to J. L. Richie, of 1233 Eighteenth avenue, about $30,000.

LaCrosse, Wis.—Construction of water works extension, to Thos. P. Wooley, LaCrosse, Wis., $33,157.

Mellen, Wis.—Furnishing 26 hydrants, to the Housellaer Valve Co., Troy, N. Y.; cast iron pipe, to the United States Cast Iron Pipe Co., Chicago.

Penticon, B. C.—Installation of water works system, to MacDougall & Co., Vancouver, 20 miles of steel and cast iron pipe, intake chambers, reservoir, etc.

CONTEMPLATED WORK.

Clarksville, Ark.—The city is contemplating the building of a municipal electric lighting plant and water works system.

Exeter, Cal.—The city is contemplating the installation of a $40,000 water works system.

Delmar, Del.—A bond issue for the construction of water works system has been voted.

Americus, Ga.—Bonds have been issued for the construction of a reinforced concrete reservoir, $105,000.

Bloomington, Ill.—Construction of the East Side water system has been authorized.

Herrin, Ill.—A $33,000 bond issue for construction of water works system has been voted.

Pana, Ill.—Bonds have been voted for new machinery for water works.

Pana, Ill.—The city is contemplating the construction of a municipal water system.

Arthur, Ia.—Bonds have been voted for the construction of water works.

Luther, Ia.—A $5,000 bond issue for water works construction has been voted.

Prairieburg, Ia.—Bonds have been voted for the construction of a water works system.

Newton, Mass.—The city contemplates digging new wells, to cost about $20,000. J. Clifton Whitney, water commissioner.

Muskegon, Mich.—The city has voted $300,000 for the construction of a water system.

St. Joseph, Mo.—The city council has ordered the laying of 1,000 ft. of water mains on Sherman avenue.

Culbertson, Mont.—A $39,500 bond issue for water works system has been voted.

Decatur, Neb.—A $15,000 bond issue for installation of water works system has been voted.

Louisville, Neb.—A $16,000 bond issue for water works construction has been voted.

Upland, Neb.—Bonds have been voted for the construction of water works.

Collingswood, N. J.—The city is contemplating the construction of a municipal water plant.

Buffalo, N. Y.—George W. Fuller, 170 Broadway, N. Y., has offered a report regarding the purification of city water supply to cost about $27,000. Hypochloride of lime is recommended.

Matteawan, N. Y.—A $60,000 bond issue for water works and sewer improvements has been voted.

Middleport, N. Y.—The village is contemplating the construction of a water works system to cost $45,000.

Charlotte, N. C.—A $350,000 bond issue

for construction of water works system has been voted.

Bedford, O.—A $38,000 bond issue for water works extension has been voted.

Cleveland, O.—The city council has authorized the construction of a West Side tunnel extension for the water department, $700,000. R. Y. McCray, city clerk.

East Liverpool, O.—The city council has ordered the extension of the water works system.

Hubbard, O.—A $30,000 bond issue for the construction of a municipal water works plant has been voted.

Oak Harbor, O.—The construction of a water works system to cost $35,000 is contemplated. It is to be a deep well system.

Sandusky, O.—The city is contemplating the addition of two or more units to the water filtration plant. Address Mayor Lehrer.

Sharon, O.—The city is contemplating the construction of a municipal water system.

Butler, Okla.—The city is contemplating the construction of a complete municipal water plant.

Grove, Okla.—The city is contemplating the construction of a water works system to cost $25,000, and municipal electric plant to cost $10,000. Bonds have been voted.

Grove, Okla.—The city has sold bonds for the construction of a water works and electric light plant.

Oklahoma City, Okla.—The city commissioners have decided to build a large dam in the Canadian river for purposes of temporary water supply. Estimated cost is $25,000.

Pawhuska, Okla.—Bonds have been voted for the extension of water works and electric light plant. $60,000.

Wellston, Okla.—A $20,000 bond issue for the construction of water works has been voted.

Somerset, Pa.—The city is contemplating water works improvements to cost $12,000. L. E. Chapin, Pittsburg, Pa., engineer.

South Sharon, Pa.—The city is contemplating the construction of a municipal water works plant.

Wampum, Pa.—The city is contemplating the construction of a water works system for which $10,000 was voted last November.

White Lake, S. D.—The construction of a $16,000 water works plant is contemplated. Maderia Valley Engineering Co., Western National Bank building, Mitchell, S. D.

Dallas, Tex.—The city contemplates building water works and sewers.

Palacios, Tex.—An $18,000 bond issue for water works construction has been voted.

Rocky Mount, Va.—The city has voted $50,000 for construction of water works, electric light plant and sewer system.

Santaquin, Utah.—Bonds have been voted for water works.

BRIDGES.

BIDS REQUESTED.

Hartford, Conn.—July 31, 11 a. m. Constructing concrete piers and abutments and steel superstructure of a foot bridge over Park river. Certified check, $200. Joseph Ruths, secretary board of contract and supply.

Tampa, Fla.—Sept. 2, 2 p. m. Constructing reinforced concrete or concrete steel bridge with bascule lift. Certified check, $10,000. Allen Thomas, clerk board of public works.

Metropolis, Ill.—August 5. Constructing Green farm bridge, reinforced concrete, two 40-foot spans, girder type; Township-line bridge, reinforced concrete, 40-foot span. Geo. C. Schneeman, county clerk.

Timewell, Ill.—August 5. Constructing reinforced concrete Hiles bridge, 18-foot span. Wm. M. Robinson, town clerk.

Albion, Ind.—Aug. 8, 2 p. m. Constructing certain bridges and culverts. J. C. Kimmel, auditor.

ing certain bridges. C. H. Jennings, auditor.

Brazil, Ind.—Aug. 8, 11:30 a. m. Constructing bridge on Otter street, as noted structing complete water works and electric light plant, as noted in Bulletin of July 8. J. D. Walpole, recorder.

Brownstown, Ind.—Aug. 7, 1 p. m. Constructing three bridges, as noted in Bulletin of July 15. H. W. Wacher, auditor.

Delphi, Ind.—August 15. Re-concreting bridge between Carroll and Clinton counties. M. G. Haun, auditor of Carroll county.

Fowler, Ind.—Aug. 7, 1 p. m. Constructing seven bridges. Lemuel Shipman, auditor.

Fowler, Ind.—August 3. Constructing 7 concrete arches in various locations in Benton county. Lemuel Shipman, county auditor.

Franklin, Ind.—August 7, 1 p. m. Constructing one reinforced concrete bridge and one steel I-beam bridge with concrete floor. W. B. Jennings, auditor.

Greenfield, Ind.—Aug. 7, 10 a. m. Repairing various bridges. C. H. Troy, auditor.

Indianapolis, Ind.—Aug. 1, 10 a. m. Constructing four culverts and one bridge. C. A. Schrader, president of board of public works.

Lafayette, Ind.—August 9. Repairing Laramie bridge. George W. Baxter, county auditor.

Lagrange, Ind.—August 8, 1 p. m. Constructing ten bridges. C. S. Willard, auditor.

Madison, Ind.—August 8, 1 p. m. Constructing concrete bridge over Crooked creek. A. M. Taff, auditor.

Mishawaka, Ind.—July 26. Constructing reinforced concrete bridge and plate girder, as noted in Bulletin of July 1. W. S. Moore, South Bend, Ind., engineer.

Newport, Ind.—Aug. 7, 10 a. m. Repairing certain bridges. H. T. Paine, auditor.

Noblesville, Ind.—August 9. Constructing concrete arches for five culverts in Hamilton county. George Griffin, county auditor.

Rockville, Ind.—August 8, 1:30 p. m. Constructing concrete bridge in Sugar Creek township. Jas. E. Elder, auditor.

Rushville, Ind.—July 28, 2 p. m. Constructing various bridge work. Jesse M. Stone, auditor.

Shelbyville, Ind.—August 12, 10 a. m. Constructing two concrete steel culverts. G. B. Huntington, auditor.

Washington, Ind.—August 7, 10 a. m. Constructing several bridges. Thos. Nugent, auditor.

Shreveport, La.—August 1, 10 a. m. Constructing substructure for a steel bridge over the Red River. Certified check, $3,000. L. H. Baker, secretary-treasurer.

Bangor, Me.—July 24, 12 m. Constructing steel superstructure of highway bridge, 217 and 223-ft. spans, as noted in Bulletin of July 15. E. E. Greenwood, Skowhegan, Me., engineer.

St. Charles, Mo.—August 17, 12 m. Constructing various bridges and culverts in the county. County highway engineer.

Nebraska City, Neb.—August 16, 12 m. Constructing two concrete bridges, one 50-foot span and one 60-foot span. Certified check, $250. A. P. Young, county clerk.

Nelson, Neb.—August 16, 2 p. m. Constructing and repairing all wood and steel bridges in Nuckolls county during the en-

suing year. Certified check, $500. L. L. Shattuck, county clerk.

Massena, N. Y.—Aug. 5, 1 p. m. Constructing reinforced concrete bridge at Massena Springs. B. S. O'Neill.

Ashland, O.—Aug. 2, 12 m. Bridge construction as follows: Constructing substructure on Emanuel Treace bridge; constructing 80-ft. Warren truss superstructure for same; constructing sub-structure for Ora Glenn bridge; constructing 30-ft. Warren truss superstructure for same. Certified check, $200 on each bid. Wm. Srideler, chairman county commissioners. Lotta Westover, clerk of board.

Bowling Green, O.—August 7, 1 p. m. Constructing bridge over Portage river, in Pemberton. Certified check, $300. F. W. Toan, county auditor.

Cambridge, O.—August 8, 12 m. Building abutments for bridge at Barnes Mill. Certified check, $50. W. D. Deselm, county auditor.

Cincinnati, O.—Aug. 11, 12 m. Constructing retaining wall along Shawnee creek. Certified check, $500. Fred Driehs, clerk county commissioners.

Hamilton, O.—August 5, 10 a. m. Constructing concrete and steel bridge in Lemon township. Certified check, 10 per cent. J. E. Brate, county auditor.

Hamilton, O.—August 9, 10 a. m. Constructing bridges over M. & E. canal, on Grand boulevard; also bridge over Tallawanda creek. Certified checks, 10 per cent. J. E. Brate, county auditor.

Steubenville, O.—August 18, 12 m. Constructing superstructure of bridge No. 17. Certified check, $100. Sherman M. Floyd, clerk board of county commissioners.

Youngstown, O.—Aug. 7, 11 a. m. Constructing the sub-structure of a bridge. Certified check, $300. Will B. Jones, county auditor.

Harrisburg, Pa.—August 12, 12 m. Constructing concrete bridge over Paxton creek. Certified check, 10 per cent. D. F. Lebo, clerk county commissioners.

Washington, Pa.—Aug. 4, 12 m. Bridge construction as follows: 110-ft. truss bridge, Monongahela City; 56-ft. plate girder bridge near Bentleyville; 56-ft. pony truss in Bentleyville; 60-ft. plate girder bridge in Finleyville; 45-ft. plate girder bridge in Peters township; 40-ft reinforced concrete bridge between Charleroi and Steers; 19-ft. steel bridge in Morris township. Certified check, $200 on each bid. John H. Moffitt, county comptroller. Chaney & Armstrong, county engineers.

Benton, Tenn.—Aug. 5, 12 m. Constructing concrete substructure and steel superstructure at Reliance. Chas. E. Johnson, secretary committee.

Vancouver, B. C., Can.—September 15. Furnishing material for suspension bridges. J. F. Griffith, public works engineer, Victoria, B. C., Can.; E. McBride, road superintendent, Vancouver.

CONTRACTS AWARDED.

Pine Bluff, Ark.—The following bridge contracts have been awarded: Three concrete bridges, to M. F. Hafie, Jr., of Dallas, Tex., $3,475; steel bridge, to M. F. Leonard, of Bouie, Tex., $1,600; wooden bridge, to G. A. McNulty, of Pine Bluff, $363.

Santa Barbara, Cal.—Constructing bridge over San Lucas creek, to Charles W. Deacon, San Luis Obispo, $33,000.

Moultrie, Ga.—Constructing steel bridges over Ocopilco creek and Ocklocknee river, in Colquitt county, to the Roanoke Bridge Co.

Caldwell, Ida. — Constructing three bridge across the Payette river, to J. H. Forbes & Co., $15,875, $15,795 and $15,950, respectively.

Bloomington, Ill.—Constructing steel bridge over Sugar creek, to Burnham & Ives, $3,600.

Clinton, Ill.—Constructing bridge in Santa Anna township, to G. A. Weaver & Son, of Clayton, Ill., $2,949.00.

Elk Grove, Ill.—Constructing one concrete arch bridge and one reinforced concrete truss bridge, to H. S. Wetherell, Elk Grove.

Macomb, Ill.—Constructing reinforced concrete bridge, to Macomb Concrete Construction Company.

Springfield, Ill.—Constructing concrete bridge, to Fitzsimmons & Wheeler, $2,100.

Taylorville, Ill.—The following bridge contracts have been awarded: Vandeever bridge, to the Decatur Bridge Company, Decatur, Ill., $3,050; Kincaid and Sicily bridges, to J. A. Smith, of Taylorsville, $1,100.

Watseka, Ill.—Constructing reinforced concrete bridge across Sugar creek, to Joseph Klein, Freeburg, Ill., $7,890.

Columbus, Ind. — Constructing Powell bridge, to H. S. Fox, $1,393; constructing Burbrink bridge, to Chas. Noblitt, $420; Waymansville bridge, to same, $540; Hubbard bridge, to Harmon Bros., $551.

Geneva, Ind.—Constructing Buckingham road in Bear Creek township, to I. O. Bears, Geneva, Ind., $3,699.

Newcastle, Ind.—Constructing new bridge over Buck creek, to H. F. Burk, Newcastle, $2,249.

Clinton, Ia.—Constructing bridges 8, 16 and 22, to the Joliet Bridge & Iron Company, Joliet, Ill., $6,910.

Iowa Falls, Ia.—Constructing bridge, to the Lana Construction Bridge Co., Harlan, Ia., $8,450.

Newton, Kans.—The county is contemplating the construction of four new bridges of steel and concrete.

Duluth, Minn.—Constructing steel bridge over O'Brien creek, to Paul H. Tweed, of Nashwauk.

Livingston, Mont.—Constructing wooden approach to the Springdale bridge, to William Sworder, $950.

Missoula, Mont.—Constructing a 120-ft. steel bridge, to O. F. Peppard, of Missoula, $3,165.

Roswell, N. M.—Constructing a bridge over the South Berrendo river, to the Mid-

Montour Falls, N. Y.—Constructing abutments of South street bridge, to the Seneca Engineering Company, Seneca, N. Y. Superstructure, to the Mountour Steel Company.

Warsaw, N. Y.—Constructing steel bridge, to the Warsaw-Wilkinson Company, $2,795.

Charlotte, N. C.—Constructing bridge, at Sloan's Ferry, to the C. W. Requerth Co., Spartansburg, S. C., $57,500.

Canton, O.—Constructing concrete bridge in Plain township, to Peter Hahn & Son, of Canton, O., $1,147.

Hamilton, O.—Constructing culverts, to Roger Evans, Joseph Conrad and J. P. Quillaum.

Middletown, O.—Constructing bridges as follows: To William Fogarty, $129; to James Fackey, $368; and to J. J. Gardner, $149.

Spaulding, O.—The following bridge contracts have been awarded: Steel superstructure on three bridges, to the Delaware Bridge & Iron Company, $1,600; steel superstructures on three bridges, to Brookville Bridge & Iron Company, $3,697; constructing abutments, to Bates & Friend, $1,246; constructing of abutments, to Johnson & Ritz, $750; constructing abutments, to Hallock & Sunday, $772; constructing culverts, to A. H. Robinson, $210; constructing culverts, to Clarence Crancer, $187.

Youngstown, O.—Constructing small bridges, to the following contractors: L. W. Mentzer and Link & Henry.

Erie, Pa.—Repairing the Mill creek bridge, to Joseph McCormick & Brother.

Kutztown, Pa.—Constructing reinforced concrete bridge, to Carl R. Camp, Montrose, Pa., $10,638.

Lebanon, Pa.—The city engineer has prepared plans for a concrete bridge across Hazel Dyke, to cost about $500.

Pittsburg, Pa.—The following bridge contracts have been awarded: Constructing masonry on Davis Run bridge, Jerry Poli; constructing approaches to bridge No. 5, to Charles Asphalk, of Carnegie, Pa., $2,000.

Reading, Pa.—The construction of the Penn street bridge is authorized.

Scranton, Pa.—Constructing sub-structure of Mulberry street viaduct, sub-let by York Bridge Co., to W. H. Lyons, of Sunbury, Pa.

West Chester, Pa.—Removing the iron truss bridge from Chester creek to White Clay creek, to Corcoran Construction Co., West Chester, $1,197; erecting new 40-ft. stone arch bridge over Chester creek, to P. J. McCormick, $3,089.

Ripley, Tenn.—Constructing steel bridge over Forked Deer river, to Joliet Bridge Co., $3,347.50.

North Yakima, Wash.—Constructing a 160-ft. combination span bridge across the Yakima river, to C. E. Lum, North Yakima, $2,340.

Fairchild, Wis.—Constructing steel and concrete bridge, to Wm. Meyers, Mondovi, Wis.

Hudson, Wis.—Construction of a bridge across the St. Croix at Walnut street to cost $120,000 is contemplated.

Victoria, B. C.—Constructing a suspension bridge at Churn creek, to C. Gardiner, Johnson & Co., Vancouver.

CONTEMPLATED WORK.

Chicago, Ill.—The construction of a bridge across the Chicago river at Washington st., to cost about $360,000, is contemplated. L. E. McGann, commissioner of public works.

Michigan City, Ind.—The county is contemplating the construction of a 125-ft. bridge across the Kankakee river.

Mishawaka, Ind.—Plans have been prepared by William S. Moore, of South Bend, Ind., for the construction of a $65,000 bridge.

Shreveport, La.—$100,000 bonds have been voted to construct steel buildings for the Louisville State Fair.

Hinckley, N. Y.—Plans have just been prepared for construction of a reinforced concrete bridge to cost $14,000.

Cleveland, O.—The council has authorized the construction of the Praha avenue, S. E., bridge, $15,000. R. Y. McCraig, city clerk.

Muskogee, Okla.—The city is contemplating the construction of rock asphalt pavement, to cost $30,000.

Reading, Pa.—The county commissioners have authorized the construction of the Penn street bridge.

Wilkesbarre, Pa.—The repairing of South street bridge, to cost $15,000, is contemplated.

York, Pa.—The county commissioners the construction of bridges to cost about $47,000.

Providence, R. I.—The board of park commissioners has selected plans for a bridge at South Park, to cost about $20,000. Corbett & Higgins, architects.

STREET LIGHTING.

BIDS REQUESTED.

San Francisco, Cal.—August 3, 11 a. m. Furnishing material and labor and installing electric lighting system at Fort Miley, Cal. Lt. Col. Geo. M. K. Williamson, D. I. M. G.

Washington, D. C.—August 1, 3 p. m. Furnishing lamp standards and brackets that may be required for various buildings under control of the Treasury Department. James Knox Taylor, supervising architect.

Brazil, Ind.—August 8, 11:30 a. m. Constructing complete water works and electric light plant. J. D. Walpole, recorder.

Columbus, O.—Aug. 1, 12 m. Labor and material for 4-75 light rectifier equipments, 320 magnetite lamps, and 2 synchronous condensers. Certified check, 50 per cent. David A. Jones, clerk department public service.

Columbus, O.—Aug. 12, 10 a. m. Installing feed wires and lights in Ohio State Sanatorium, at Mt. Vernon, O. Bond, 50 per cent. B. O. Probst, secretary.

Lancaster, Pa.—July 31. Furnishing and installing lighting fixtures in the new contagious hospital, county almshouse. Certified check, 15 per cent. H. Frank Eshleman, county controller.

Union City, Pa.—Street lighting for five years, to the Union City Electric Light, Heat & Power Co.

CONTRACTS AWARDED.

Clarksville, Ark.—The city is contemplating the building of a municipal electric lighting plant and water works system.

El Modena, Cal.—The city is contemplating the installation of an electric light and power system.

Sacremento, Cal.—The state legislature has voted an appropriation of $103,000 for the gas and electric power plant.

Fort Collins, Col.—The city is contemplating the construction of a municipal electric light plant.

Albany, Ga.—A $50,000 bond issue for construction of a municipal gas plant has been voted.

Elmwood, Ill.—The city is contemplating the installation of an ornamental lighting system.

Shirley, Ind.—The city is contemplating the installation of an electric light and power system.

Melbern, Kan.—The city is contemplating the construction of an electric lighting plant.

Grand Cane, La.—The city is contemplating the installation of a complete electric lighting system.

Takoma Park, Md.—The town is contemplating the installation of an electric lighting system.

Mansfield, Mass.—A bond issue of $22,500 for construction of municipal light plant has been voted.

Marshall, Mich.—The city is contemplating the installation of an ornamental lighting system.

Bamby, Minn.—The city is contemplating the installation of an electric lighting plant.

Montclair, N. J.—The city has signed a five-year contract for street lighting with the Public Service Gas Co.

Stone Harbor, N. J.—The city is contemplating the construction of a gas plant.

Binghamton, N. Y.—Plans have been completed for a boulevard lighting system.

Valley City, N. D.—Supplying electric lamps for the city, to the Bryan-Marsh Co.

New Philadelphia, O.—The County Electric Company has been incorporated by S. L. Londen, H. K. Bradner, L. H. Purcell, M. R. Thornton, and H. Sellers, to furnish light for New Philadelphia and surrounding towns.

Grove, Okla.—The city is contemplating the construction of a water works system to cost $25,000, and municipal elec-

tric plant to cost $10,000. Bonds have been voted.

Pawhuska, Okla.—Bonds have been voted for the extension of electric light plant and water works, $60,000.

Chambersburg, Pa.—The city is contemplating improvements in the electric light plant to cost about $20,000.

Charleroi, Pa.—The city council at its meeting on July 18 will consider the awarding of contract for lighting city streets for a period of years.

Harrisburg, Pa.—The Central Pennsylvania Traction Co. is contemplating the purchase of a 1,600-k.w. generator.

Lebanon Pa.—A charter has been granted to the West Lebanon Light & Power Co. for providing light and power for the township. The incorporators are Daniel Weaver, Jacob B. Weaver, Henry Weaver, Raymond F. Bicksler and John S. Weaver.

Pottstown, Pa.—The city is contemplating the construction of electric light plant to cost about $75,000.

Smithton, Pa.—The city has granted a franchise to the Smithton Light, Heat and Power Co., for city electric lighting.

Washington, Pa.—The Washington Electric light plant has been purchased by Van Horn Ely, of New Brighton, $600,000.

Brookings, S. D.—Furnishing electric lamps, to the Bryan-Marsh Co.; transformers, to the Fort Wayne Electric Works, and wattmeters, to the General Electric Co.

Hardwick, Vt.—A $65,000 bond issue for electric lighting extensions has been voted.

Rocky Mount, Va.—The city has voted $50,000 for construction of water works, electric light plant and sewer systems.

Seattle, Wash.—Furnishing electric meters, to Burton R. Stare, $40,928.36.

Tacoma, Wash.—Installing lighting system in the court house, to Caldwell Bros., about $3,000.

Beaver Dam, Wis.—The city is contemplating the installation of an ornamental lighting system.

La Crosse, Wis.—The city is contemplating the construction of an electric light plant. Address Harry C. Wilson.

CONTEMPLATED WORK.

Minden, Neb.—Bonds have been voted for the construction of a municipal electric light plant, $15,000.

Grove, Okla.—The city has sold bonds for the construction of a water works and electric light plant.

Eugene, Ore.—The city water board will purchase poles for the city lighting system.

Plankinton, S. D.—A franchise for installing an electric light plant has been granted to W. A. Kuntze.

Walla Walla, Wash.—The city clerk will advertise for bids for furnishing electrical power for the arc and cluster lights in the city for five and ten-year periods.

Fond du Lac, Wis.—The city council has voted to install ornamental electric lights in Main street.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

BIDS REQUESTED.

Paterson, N. J.—August 16. Disposing of the city garbage. Board of public works.

Cleveland, O.—August 16, 12 m. Purchasing garbage tankage of the disposal plant for period from September 1 to December 31, 1911. Ira C. Hoffman, secretary director of public service.

CONTRACTS AWARDED.

Lexington, Ky.—Cleaning streets for a period of seven months, to the Home Construction Company, Lexington, Ky.

Canton, O.—Collecting garbage for next five years, to the Sanitary Garbage Co., of Mansfield.

Erie, Pa.—Appropriations for the garbage plant have been made as follows: $12,000 for horses and wagons, $17,000 for two furnaces from the Morse-Bugler Co., New York, $11,000 for land.

Philadelphia, Pa.—Constructing municipal crematory at hospital for contagious diseases, to John R. Wiggins & Co., $8,300.

CONTEMPLATED WORK.

Newark, N. J.—The city is contemplating the installation of a garbage disposal plant.

Cleveland, O.—The city is contemplating the construction of a joint garbage disposal plant with Akron, O.

Massillon, O.—The city is contemplating the construction of a garbage disposal plant. Director of Service Pietzcker.

Oklahoma City, Okla.—The budget of the health department includes $26,700 for an incinerating plant and the purchase of an automobile ambulance.

Newcastle, Pa.—The city is contemplating the installation of additional equipment in the garbage disposal plant.

Seattle, Wash.—The city is contemplating construction of three garbage incinerators, to cost $120,000. R. H. Thompson, city engineer.

FIRE APPARATUS.

BIDS REQUESTED.

Kansas City, Mo.—August 2, 2 p. m. Constructing fire station. City purchasing agent.

CONTRACTS AWARDED.

Alice, Minn.—The village has purchased a $465 chemical engine.

CONTEMPLATED WORK.

San Jose, Cal.—A $60,000 bond issue for fire department equipment has been voted.

Thompsonville, Conn.—The city is contemplating the purchase of an auto-propelled fire truck. W. H. Hines, chief.

Boise, Ida.—A $40,000 bond issue for purchase of new fire apparatus, including an 85-ft. aerial truck, has been voted.

Belvidere, Ill.—The city is contemplating the purchase of a motor fire truck to cost about $6,000.

Ottawa, Kan.—The city is contemplating the purchase of an auto chief's wagon.

New Orleans, La.—The city is contemplating purchasing combination chemical and hose wagon motor propelled.

Bentnor City, N. J.—The city is contemplating the purchase of an auto combination wagon.

Akron, O.—The city is contemplating the extension of a fire alarm system and the purchase of motor propelled fire apparatus. Safety Director Benner.

Massillon, O.—A bond issue for the purchase of 1,000 ft. of hose has been voted.

Oklahoma City, Okla.—The estimate of the chief of the fire department for the next year includes $16,000 for extra equipment and new alarm boxes, and $5,500 for combination hose and chemical wagon.

McKees Rocks, Pa.—The commissioners have authorized the purchase of 2,000 feet of fire hose.

Honolulu, H. I.—The city and county board of supervisors contemplate the purchase of two auto fire trucks for chemical apparatus, to cost about $6,000 each.